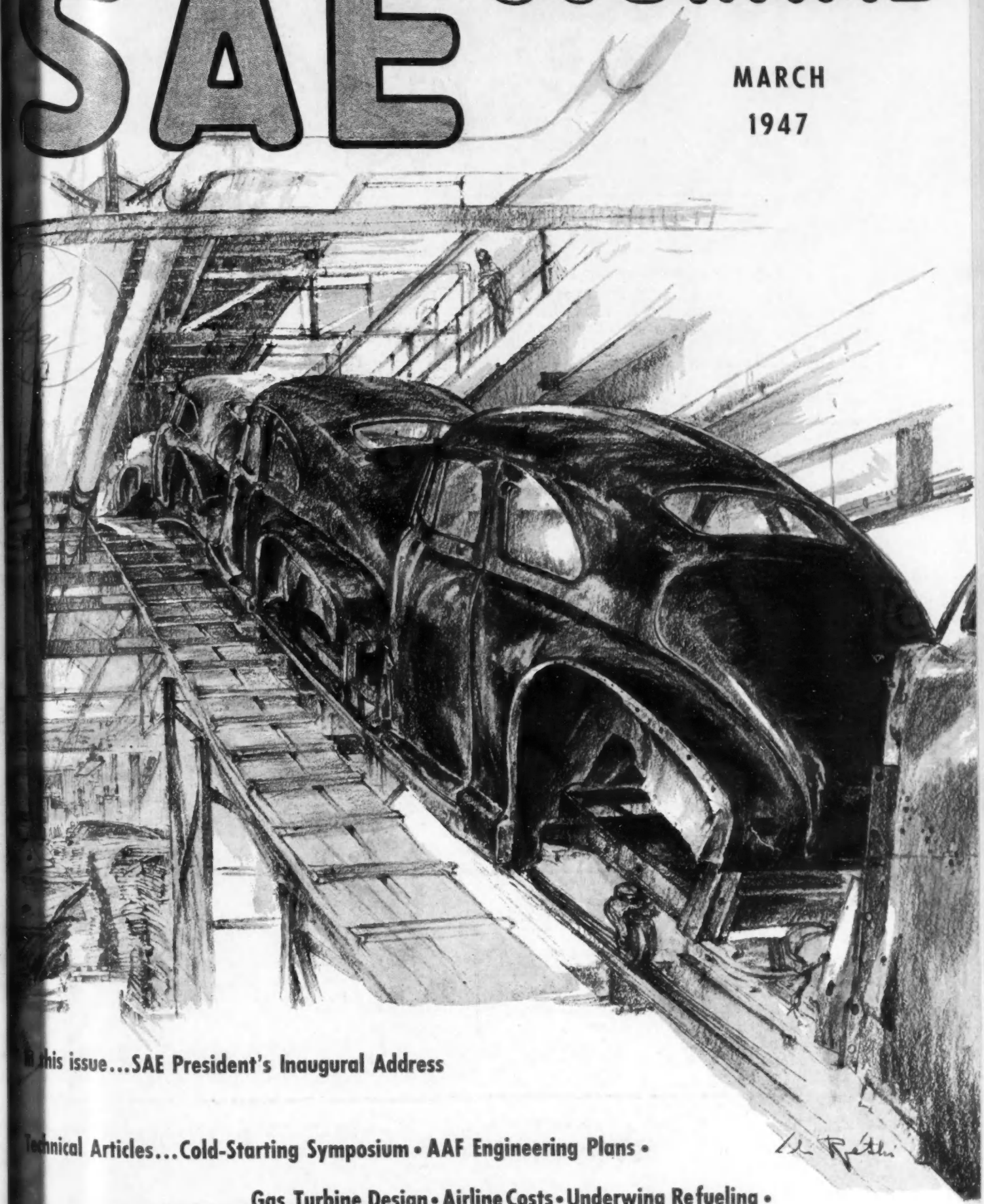
SAE JOURNAL

MARCH
1947



In this issue...SAE President's Inaugural Address

Technical Articles...Cold-Starting Symposium • AAF Engineering Plans •
Gas Turbine Design • Airline Costs • Underwing Refueling •
Stainless Steel Bodies • Future Engines • Two-Way Radio

Rumor Page

IT'S RUMORED THAT

autos are now being made out of glass!

If by glass you mean Fiberglas, you're right, Mr. Wright. The car is an invention of William Stout who says "That the entire auto body, including doors, floor, roof, sides and ends, is constructed of Fiberglas. I think it's the car of the future!"

Contributed by G. D. Wright
Portland, Oregon

IT'S RUMORED THAT

women are better drivers than men!

You've heard (maybe said) the opposite for years. But listen to this: According to an announcement from the National Safety Council last year, although women held 27% of the drivers' licenses, they accounted for only 12% of the accidents! Er, think your wife ought to see this?

IT'S RUMORED THAT

P. C. was the first piston ring manufacturer to install engine test facilities!

Right. And Perfect Circle ever since has maintained the largest and best equipped engine lab in the piston ring industry, where many a tough problem has been licked. If *you* have an engine problem, why not ask for help? P. C. engineers will be glad to work with you to find the proper solution.

IT'S RUMORED THAT

thin engineers live longer than fat engineers!

True, according to Mr. C. A. Flitcraft, who says, "Regardless of whether a man's an engineer, a doctor, a lawyer or an Indian chief, if he's thin, chances are he'll live longer." Mr. Flitcraft ought to know—he is a leading underwriter of Penn Mutual Life Insurance Company.

The Perfect Circle Company, makers of Perfect Circle *Custom Made* Piston Ring Sets, will pay fifty dollars ($50) for each rumor, fact or fiction, accepted for this page. Send your rumor to Rumor Page, Perfect Circle, Hagerstown 9, Indiana. All contributions become our property and cannot be returned or acknowledged.

The Cover

● Despite complexities retarding a nation returning from war to peace time production, the automobile industry is rolling passenger cars off its production lines with increasing speed.

Dramatic example of typical U. S. production engineering ingenuity is the Linden (N.J.) plant of General Motors Corp., which was designed to assemble Buicks, Oldsmobiles, and Pontiacs on a single final line.

Rear guard planning far back of production of parts in hundreds of suppliers' factories is indispensable in achieving steady output in assembly plants. There stop-watch precision controls speeds of many conveying systems, such as the body line shown on our cover, and finally synchronously converges them all into one.

For the Sake of Argument

by NORMAN G. SHIDLE

Happy is the man who carries unfinished business around in his heart. The Efficiency Edgars who complete everything they think of starting walk the precipice of emptiness and boredom.

Great comfort rises from a subconscious stored with unexecuted projects which have never been started, ideas which hibernate forever in the seed stage. Those unfinished concepts are places of refuge from storms of everyday life. "Even if I do get fed up with this job . . . even if I get fired," you find yourself soliloquizing, "I've always got that book to write . . . that engine to design . . . or that sales idea to try out." The very existence of a stimulating task to which to turn makes the turning to it less likely, less necessary.

Every writer is bountifully blessed with unfinished work . . . Not only does he have plenty of it, but rests serene in the certainty that – if he ever did get around to it – it would be much the best he ever turned out. Plenty of successful scriveners have kept happy at humdrum tasks buoyed up by the thought that they surely would do something remarkable – mañana. Kept within bounds, this sort of self-hypnosis helps the writer and hurts nobody else. Business men, on the average, could do with a little more of it than they usually indulge in.

Too much unfinished business (real or fancied) will, of course, stir emotional indigestion. But applied as a sauce, rather than a diet, it sharpens the appetite for regular food.

FOR PROFITABLE ASSEMBLY

Let TINNERMAN *analyze your fastening problems*

BEFORE You Leave the "Mock-up" Stage

Just as the Galvin Manufacturing Corp. did with their new Motorola Auto Heater

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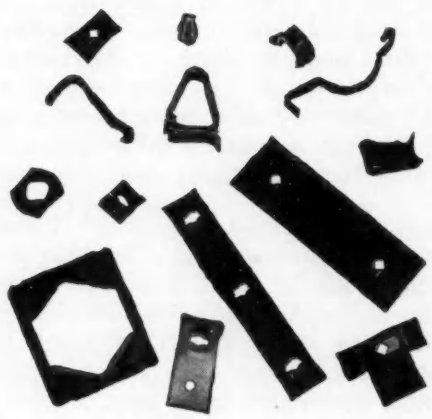
These 14 different types of SPEED NUT Fasteners —44 parts in all—solved Galvin's problems



Our new Bulletin No. 214 goes into detail on this Motorola job and is available for the asking. Since you may be able to use to advantage many of the fastening ideas illustrated, write for a copy today.

To take full advantage of the SPEED NUT System of Fastening, Galvin engineers brought the "mock-up" and prints of their new Motorola Heater to Tinnerman for a fastening analysis *before* building tools and dies. They sat right in with Tinnerman development engineers who went over the heater part by part—explored every possible production short cut—planned its assembly from start to finish.

The final design of the heater was modified to take advantage of *standard* SPEED NUTS wherever possible. Where standards could not be used, new SPEED NUTS were created for a more efficient assembly. The result was *assembly perfection.* Many parts were attached with SPEED CLIPS and merely snapped into position under spring-tension. Others were fastened by simply pressing SPEED NUTS over unthreaded studs. And where it was necessary to use screws, SPEED NUTS made the attachments simple and fast.

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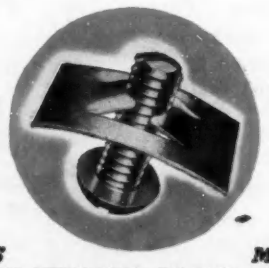

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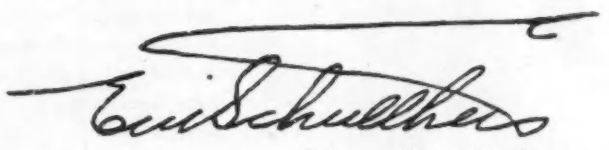
Member Quality High . . .

Caliber and quality of SAE membership has been fully maintained throughout the years of tremendous growth just behind us. As our numerical strength has tripled during the past decade, admittance standards have been applied as rigorously as ever. Associate members comprise about the same percentage of total membership today as they did 10 years ago. Additions to all grades of membership have vastly increased the range of knowledge covered and the volume of information and ideas available for exchange under SAE auspices.

Care in selection of prospects by Activity, Section, and Group Membership Committees has been potent in getting these good results. Painstaking study of applicants' qualifications by Grading Committee and Council has completed the process. (Insistence by Grading Committee and Council on doing their job thoroughly, incidentally, is a sound reason for the length of time required for processing an application.)

We all are eager to see SAE continue to grow. Every member can help by "talking" SAE to others.



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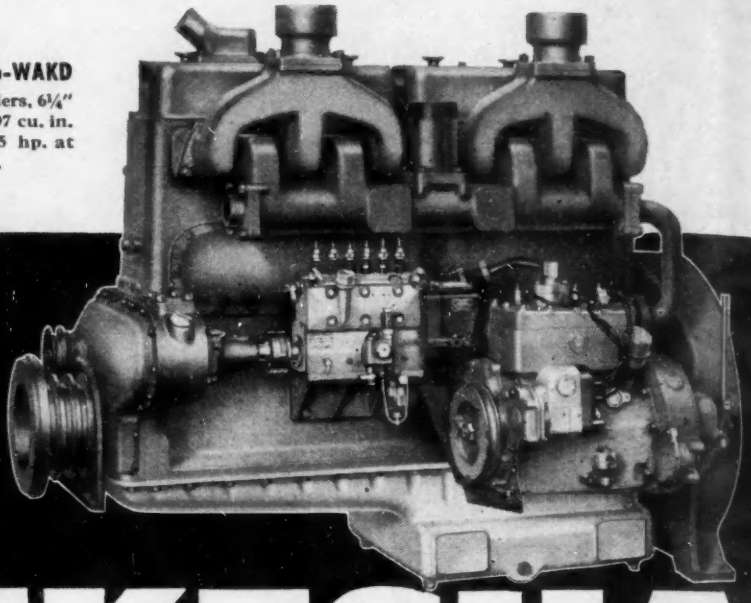

TAKE A LOOK AT THIS HUSKY QUICK-STARTING HIGHLY FLEXIBLE

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● This big, new, four-cycle Waukesha Diesel is packed with *performance proved* features that give super power, smoothness and acceleration, high fuel economy, and longer life with lower upkeep.

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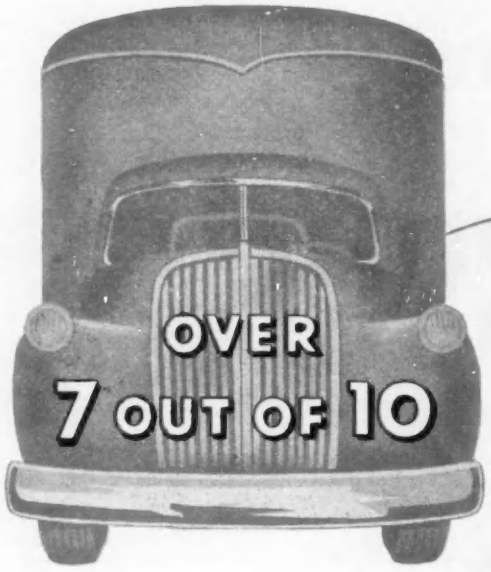
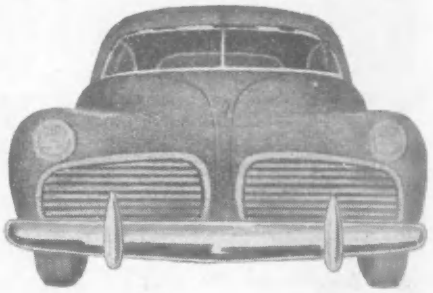
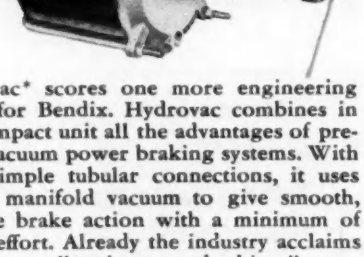


Automotive Vehicles Ever Built have been Better Because of



Bendix Engineering



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The dictionary defines engineering as "the science and art of constructing and using machinery." In no other industry has progressive engineering achieved such outstanding results as in the automotive industry. Bendix* has been the partner of this progress for over thirty years, and has always held a prominent place in the vanguard of new engineering development. Tomorrow, as in the past, the industry can confidently expect the *best* from Bendix—First in Creative Engineering.

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A Message from Our President

By C. E. Frudden, SAE President for 1947

I DEEPLY appreciate this honor and humbly accept the job of serving SAE as its President during 1947. Simply to have one's name included in the list of those distinguished and devoted men who have served the Society in this same capacity is a great honor. The responsibility, however, for maintaining the same high level of leadership which has been displayed by the 40 presidents since the Society's founding is, I realize, no mean undertaking.

As a background for this new effort, it has been my fortunate experience to have served on several of your technical committees and also on the National Council and on committees for nominating national officers. In these experiences I have seen many of the Society's leaders at work and one cannot experience these associations without being tremendously impressed by what appears to be an almost religious devotion to this Society by its active members and officers. These men continue year after year to give generously of their time, talent and effort to further promote the Society's well being with very little thought of personal gain or reward. And this impression of real devotion seems also to have permeated the ranks of the management staff which keeps wheels moving while elected officers come and go. To mention the names of any individuals would be to detract from the tribute here intended.

For myself I am looking forward to a well-filled year in this new service, which it is hoped will be partial recompense for the lessons and inspirations that have come to me during some 30 years of membership in SAE.

Reviews Expansion

This 30-year period has made considerable history. Thirty years ago the SAE, then the Society of Automobile Engineers, enlarged its horizons and extended memberships to all engineers engaged in all branches of engineering related to internal combustion engines. This move was an invitation to the tractor and to the aeronautical engineers to join the Society, which invitation they accepted, and the election of a president for this year from the ranks of those who are associated with the development of automotive equipment for agriculture and earth moving is accepted as a tribute to the efforts and accomplishments of this group in SAE affairs. I should like to review briefly some of these for you.

During the war years and since, this country has become definitely food conscious. Not only do we demand to be well fed ourselves, but we have a further responsibility of sharing our home-grown food with others less fortunate than we are, which brings us to a recognition of the marvelous accomplishments of our food producers; the American farmers. Within this 30-year period of SAE growth the number of farmers has been reduced from one-third of our total population to one-sixth

Mr. Frudden's Inaugural Speech was presented Jan. 8 at the Annual Dinner of the Society, Detroit Masonic Temple.

– that is, percentagewise it has been cut in half – and at the same time production has increased enormously. Many factors, of course, contributed to this wonderful record of accomplishment, but, according to foremost Government authorities on the subject, by far the greatest factor has been the replacement of work animals with automotive equipment – that is, by the tractor and its associated implements. This has increased the day's work of a man, and equally important, this change has released 50,000,000 acres of crop land and many more million acres of pasture land from the growing of feed for work animals, to make these acres available for production for market. Thus current agricultural production is now largely for human food and the fuel for power production is being obtained from the buried plants which grew millions of years ago during the carboniferous era; in other words, gasoline and tractor fuel.

. . . this country has become definitely food conscious . . . During the past 30-year period of SAE growth the number of farmers has been halved . . . Due to more automotive vehicles, food production has increased enormously . . .

One enthusiastic agriculturist has put it this way: Improvement in agriculture from grandfather's day to the present equals that of the whole period from the time of Moses and the Pharaohs up to grandfather's time.

Automotive engineers designed and built their tractors by capitalizing on the developments for transportation, of internal combustion engines, precision gears, antifriction bearings, alloy steel, rubber tires, and so forth. Adopting these developments to agriculture has resulted in a great achievement, and through the cooperative effort such as SAE provides, the tractor has been established as a highly efficient automotive mechanism.

Cites Aircraft Contributions

But progress continues. With the tempo of farming speeded up by the use of tractors, some farmers in collusion with another branch of automotive engineers see great opportunities for use in agriculture of the aeroplane, which can work fast *above* the farmer's fields instead of at a very slow pace *in* them. Already cotton farmers in the south are making good use of this new farm tool. With it, fields are dusted with insecticides to kill obnoxious insects, covering huge acreages in a very short time for maximum effectiveness and efficiency; and with it chemical defoliants are spread over the fields before picking time to remove the leaves. This speeds up the ripening of the growing plants and increases the effectiveness of the recent mechanical, automotive-type of cotton pickers. Then, also, he seeds his cotton fields, using aeroplanes, before the crop is harvested, to produce a luxuriant growth of cover crop, which, when plowed under, provides a seedbed for higher crop yields the following year.

Rice also is planted by planes on fields too wet for tractor operation and so the circle of usefulness increases.

The aeroplane is definitely a farm machine in these instances, and in its time will undoubtedly find many more useful applications in agriculture outside the field of transportation.

This considerable emphasis on SAE accomplishments in the field of agriculture is not an intentional disrespect for the accomplishments in motor transportation, in fuel and lubricants, or in any of the other SAE activities. Your newly elected president, unfortunately, is not a qualified expert in all of the automotive fields and therefore has been forced to use the environment of his own experience to form the background for this message.

These instances of development and growth are mentioned to provide added inspiration in connection with the tremendous potential for accomplishment by engineers tied together as in SAE for the purpose of solving their basic engineering problems. With basic problems and those requiring the cooperative effort of many specialists in associated fields, centered in the activities of any organization like SAE, the stage is set for subsequent highly competitive individual effort which makes our economy progress. The SAE organization with its Sections and Groups, its activities, its technical committees, and its Technical Board, all supervised by a well-organized management staff, forms a most effective clearinghouse for the ideas of all automotive engineers, and then a springboard for action.

The Society chooses to remain purely technical in its various activities and refuses to take any part in pressure group or political arguments. Its growth to a present total membership of some 16,000 indicates its standing among technical men in its field.

With this record of continuous and healthy growth to look back upon, the course for the immediate future is felt to be already set, and the new administration, counting on the loyal support of the active membership, can assure the Society bright prospects.

. . . With basic problems requiring cooperative effort of many specialists centered in SAE, the stage is set for subsequent high competitive individual effort which makes our economy progress.

AAF PLANS for ENGINEERING and RESEARCH

EXCERPTS FROM PAPER BY **Major-Gen. L. C. Craigie***

THE Engineering Division of the Air Materiel Command is the agency of the Army Air Forces charged with the responsibility of placing engineering and research planning into operation.

There are three primary requisites to a successful research and development program – funds, qualified manpower, and facilities.

Funds is undoubtedly the primary factor since training and employment of manpower and construction, maintenance, and utilization of facilities also involve funds. Since the end of the war it has become increasingly apparent to us that the present and future research and development program of the AAF will be limited to that which can be accomplished with funds appropriated specifically for the purpose. Our planning must take this into consideration.

The tremendous technological advances that occurred during the war, particularly in the field of aeronautics not only resulted in much more complex aeronautical equipment (and hence more expensive) but greatly widened the scope of our research and development. Before the war, we were concerned primarily with one type of power plant – the reciprocating engine. Today we have five additional types to develop: the gas turbine for jet propulsion (turbo-jet), the gas turbine for propeller drive, the intermittent jet (similar to the one used on the German V-1 or "buzz bomb"), the pure ram jet, and the rocket motor. You can add to that a more than academic interest in the possibilities of utilizing nuclear energy for propulsion purposes. Electronics is a comparative newcomer in military circles and offers many possible applications. Guided missiles, with their expendable characteristics, are extremely costly in the development stage. The obvious fact that any future war will be global in nature makes it necessary to have all our equipment operational under any and all geographical and climatic conditions with the possibility of going from one extreme condition to another in a matter of a few hours. Such a requirement means costly development.

The above facts result in three obvious conclusions: first, that the peacetime research and development program of the AAF must stand on its own feet, supported by the funds which the Congress deems ample for the purpose; second, that the annual appropriation, measured by prewar standards, will have to be generous (we estimate in the neighborhood of $250,000,000); and, third, that such funds will have to be expended in accordance with a well conceived and long range program to insure that we get a dollar's worth of development for every dollar spent.

In qualified manpower, this country is most fortunate. Probably no nation in the world values so-called higher education as much as the United States. Our youth are technically and scientifically minded; they seek education in those fields, and there should never be a shortage of scientists or engineers. Likewise, as the world's greatest industrial nation, we are, and should continue to be, rich in skilled and semi-skilled workers. As a consequence, our research and development planning is not hampered by lack of scientists, engineers, or skilled workmen within civilian laboratories and industry to carry on the program we plan.

Within the Army Air Forces, the condition is somewhat less fortunate. The limitations on compensation for Civil Service employees make it difficult for us to compete with industry in acquiring high caliber scientists and engineers. We have managed to improve this situation in recent years and expect further moves in the direction of making government Civil Service more attractive.

We are faced with a similar condition in our

*Paper "Engineering and Research Planning of the Army Air Forces," by Major-Gen. L. C. Craigie, Air Materiel Command, was presented at SAE 1947 Annual Meeting, Detroit, on Jan. 7, 1947.

military personnel. As you probably know, the AAF has been authorized a total commissioned strength of 25,000 regular officers, and is in process of considering applications for about 17,000 vacancies. We are particularly disturbed at the scarcity of applicants with good technical background.

Expanded Facilities Needed

Probably the factor of facilities is more disturbing to our future planning than anything else. The vast industrial expansion which the Government financed during the war was primarily for production and did not augment experimental testing or research facilities to any great degree. Moreover, present-day emphasis on supersonic flight, guided missiles, new electronics applications, new propulsion means, and the like has created a need not only for research facilities of wider scope but also for new types of such facilities.

All existing AAF Engineering Division facilities are severely taxed to keep pace with the fast-moving progress of technology. The emphasis on supersonic flight, guided missiles, new propulsion means, and electronics development has established requirements for a whole new set of test facilities. Study of these requirements has resulted in a proposal to build the so-called Air Engineering Development Center. The contemplated Center would provide industry as well as Government agencies, charged with the development and procurement of aeronautical material, with adequate evaluation testing facilities. These would include wind tunnels for testing aircraft, missiles, complete propulsion systems, etc. Velocities ranging from subsonic to supersonic would be available at will. Temperature and density conditions corresponding to the standards for altitudes above 80,000 feet above sea level could be selected. Other facilities would accommodate the components of specific propulsion systems such as turbines, compressors, ducts, nozzles, etc. There would be rocket test stands suitable for units having thrusts of tremendous magnitude. Additional facilities are planned for test of structures, materials, instruments, electronics equipment, fuels, and biophysics items.

The cost of this Center is such that no unit or practical section of industry could sponsor or duplicate it on a sound business basis. It definitely should be government financed but available to industry as well as Government agencies for testing and evaluation purposes. AEDC personnel would operate the facilities but would, insofar as practicable, conform to the desires of the contractor or manufacturer in the types of tests to be made and the procedures to be followed.

One specific technical question which might be appropriate at this time is "Just where do we stand with respect to aerodynamics power plants, and other types of aeronautical equipment?" My answer: "We stand about where the Wright brothers stood when they were contemplating their first flights some forty-odd years ago." I don't expect you to take that statement too literally but the point I'm trying to get across is that the future of military aviation depends upon the solution of many aerodynamic, mechanical, and physical problems as unrelated to our past experience as those which confronted the Wrights when they first decided that man could utilize air as well as ground or water to support a transport vehicle.

So long as we stayed in the realm of subsonic flight, tried and proven methods and formulas gave us steady and continued improvement in both aircraft and aeronautical equipment. We shall continue to use these tried and proven methods since we have not reached the ultimate in subsonic aircraft and since there is still a military need for such aircraft. On the other hand, some of our aircraft are already nosing into the transsonic speed range and we are developing pilotless aircraft and guided missiles for supersonic speed application. It is in this upper realm of flight that our problems become most complex. When air no longer acts as air but takes on the characteristics of first, a semi-fluid, and then, a fluid, the design of an aircraft that will fly in such media becomes quite an assignment.

Subsonic Problems

Let us first consider some of the major problems which exist in the subsonic field.

Since a good portion of the past war was fought in tropical, semi-tropical, and temperate regions, we have considerable experience with operation under the conditions of those regions and have solutions for most of the problems encountered. We are not as familiar with operations under conditions of severe cold. Because of this, as well as the obvious strategic value of the Arctic region, we are placing great emphasis on so-called "winterization" of aircraft, aeronautical equipment, and personal equipment. Most of these problems are not new – wing and propeller deicing, cabin and cockpit heating, cold engine starting, low temperature lubricants, cold weather maintenance, and the like have been with us for some time. In all these fields better solutions to these problems are mandatory.

Possibilities of global warfare make it imperative that we have transport and cargo aircraft of such size and in sufficient quantities to move entire divisions of fully-equipped ground troops over thousands of miles in a minimum of time. Such aircraft present few new basic problems but will necessitate ingenuity in design of droppable cargo compartments and containers, adequate escape means, and improved sea rescue equipment. All equipment, including that used by the Ground Services, will have to be designed for possible air

transport and will therefore have compactness and lightness as prime requisites. One big problem in large transport and cargo aircraft is operation in and out of ill- or unprepared landing areas. The track landing gear on which we are now working shows considerable promise in this field.

One subsonic aircraft which deserves mention is the helicopter. It has demonstrated that it has many special purpose uses and its further development is a military necessity. An interesting design on which we are now working is the so-called "flying crane," intended to transport and deliver heavy loads over short ranges and to relatively inaccessible places. We are doing considerable rotor blade research in an effort to determine best blade shape and construction, best material, and how to overcome the hazards of icing and abrasion. Some development work on jet-propelled rotors is under way.

For at least an interim period, our combat aircraft will remain in the subsonic range. This is particularly true of long range, piloted aircraft and the problems here are primarily of improvement in existing technique and controls.

Electronics is playing an ever-increasing role in all of our automatic flight aids, in enemy detection devices, and in countermeasures against enemy electronic weapons.

So far as power plants are concerned, the reciprocating engine is still our best bet for long range, sub-stratosphere flight at subsonic speeds. However, the propeller-drive gas turbine gives indication of becoming a strong competitor. The reciprocating engine, particularly with compounding, has the advantage of low fuel economy which other types of power plants will not equal for some time.

Trend to Larger Propellers

The propeller picture is colored by the necessity of providing for engines, both reciprocating and turbine, of higher horsepower. The trend is toward much larger propellers, either in diameter or number of blades for subsonic operation. Hub studies are aimed at reversible pitch with high rate of change and safety measures to prevent changes not definitely called for by the controls. Turbine engines with their peculiarity of operating best at close to top speed offer a difficult problem of governing and this study is now receiving considerable attention.

Our major problems today are due to the advent of extremely high speeds.

Major aircraft structure problems have to do with wing and control design, nacelle installations, materials, and escape provisions. In wings and controls, indications are that either sweep-back or sweep-forward possibly coupled with a thin diamond-shaped airfoil section offers the most promising solution. For strength purposes, the thin wing will undoubtedly be thick-skinned. Nacelles, particularly jet engine nacelles, need exhaustive wind tunnel tests with both single and multi-engine types of various shapes to determine the most efficient configuration. Such other protuberances as radome blisters, gun turrets and the like will have to be eliminated or minimized. Material problems are concerned chiefly with combatting the high friction heat that accompanies high speed. It is quite possible that a metal sandwich construction will be the answer. Another problem created by high operating speeds is the matter of pilot and crew emergency escape from aircraft. The pilot ejection seat development is progressing satisfactorily and similar studies to take care of crew members are now under way.

Supersonic Problems

Powerplants to propel us through the transsonic and supersonic ranges are a problem particularly from the fuel economy standpoint. All the new types meet the power requirements but, as yet, high fuel consumption limits the useful range of flight. Even greater powers will be available from most of these types as soon as materials of higher heat resistance are developed.

The extreme accelerations encountered in supersonic flight have also complicated power plant development. Where conventional engines were called upon to operate at maximum rates of climb in the neighborhood of 5000 fpm, we have pilotless aircraft contemplated which will have rates of climb in excess of 100,000 fpm. Equipment to stand up under this extreme flight condition must be mechanically capable of withstanding very high accelerations. In addition, the rate of response of the engine, the engine controls, and the fuel metering system must be greatly increased.

Propeller people contend that supersonic flight does not put them out of business, nor does the jet engine. They argue that existing information indicates that application of the same basic principles that make aircraft fly at supersonic velocities will permit propellers to give commendable performance at these same velocities. They are convinced that the gas turbine directly geared to a relatively small propeller of 5 or 6 ft diameter consisting of a multiplicity of solid metal, highly stressed blades is a likely solution to supersonic flight. They admit that they can't operate where there is no air and reluctantly relinquish that domain to rocket propulsion.

In the field of armament high speeds force us to use automatic devices to a maximum degree. Our engineers are, therefore, devoting every effort to development of fire control systems which will automatically locate a target whether in the air or on the ground or sea and insure a hit every time a gun is fired or a bomb released.

In electronics, supersonic flight has interposed some difficult problems. The early warning range of 200 miles now available must be extended to several thousand miles; ambient temperatures of equipment used in pilotless aircraft must be stepped up to several hundred degrees; there is a requirement for added information on wave propagation characteristics if we are to solve problems involved in the guidance of pilotless aircraft at very high altitudes. Coincident with this latter problem is the necessity for an aggressive and comprehensive upper air research program.

Aerial Photography

Aerial photography is one phase where we have kept pace with aircraft speeds. The shutterless moving film camera is capable at this moment of obtaining clear photographs at 100-ft levels at speeds which no aircraft has yet attained. At higher altitudes the problem is even simpler. For extremely high altitude use we are presently developing a 144-in. lens. This 12-ft focal length will give us better photographic definition than we had from any of our cameras used during the war.

The physiological side of high speed flight is indirectly reflected in aircraft design and is a major problem. Man is not constructed to absorb the terrific accelerations and decelerations which are likely to be encountered in supersonic flight. Moreover, he cannot exist in a vacuum. We are conducting exhaustive tests to determine his limitations and provide the means of overcoming them. We have already developed a light weight pressure suit which has been tested successfully to a simulated 80,000 ft. The ultimate suit will probably be a one-piece affair incorporating a wide thermal range, with heating and refrigeration units, pressurization provisions, anti-G protection, parachute harness and flotation means incorporated, and flexible enough as not to impair flying efficiency.

Until facilities such as are contemplated for the AEDC become available, we are limited in the means with which to conduct tests essential to solution of the problems of supersonic flight. However, we do expect to learn a great deal through use of piloted rocket test planes such as the XS-1 and XS-2 and remotely controlled jet planes like the P-80 in which results can be observed through telemetering devices. Considerable publicity has been given the recent flights of the XS-1 and I would like to correct any erroneous impressions that may have resulted from such publicity. The XS-1 is in no sense a military aircraft. It is the product of a harmonious program of the AAF, Bell Aircraft Corporation, and the NACA. It is essentially a flying laboratory whose mission is to investigate and study flight and design research problems at high speeds.

The intention is to make repeated short flights with the XS-1, each a little faster than the preceding one, feeling out the controls, the behavior of the airplane, and the operation of the rocket power plant. In all probability, throughout this flight test program, we will repeatedly get into trouble, study the situation, devise corrective measures and proceed to the next phase.

The XS-1, a research tool, is the first of four airplanes, the development of which is sponsored by the AAF in collaboration with aircraft manufacturers and the NACA for the purpose of exploring the phenomena of high speed flight. The information resulting from the flight test of these aircraft should go a long way in solving many of the problems I have briefly outlined for you in this discussion.

In all of our planning, one corollary is of utmost importance – the retention of a healthy aeronautical industry. One factor which will have decided bearing on the health of industry is the type of procurement legislation adopted. The War Powers Act, which is still in effect and will continue to be our authority until six months after Congress declares the emergency over, gives us considerable freedom of action in the placing of our contracts. When the War Powers Act no longer prevails and unless Congress passes some new legislation, we revert back to the Air Corps Act of 1926 for our procurement authority. That Act places the emphasis on competitive bidding in the awarding of contracts rather than on the ability of prospective contractors to produce. A new act, designed to retain the beneficial features of the War Powers Act, has been submitted to Congress and is ready to be acted on in this present session.

Buying Powers Asked

Under the new legislation, we would be given discretionary powers to contract for research and development with or without competitive bidding. We appreciate the advantages of competitive bidding and, even under the War Powers Act, have continued to ask for informal competitive proposals which we carefully evaluate before selecting the contractor.

An additional innovation for which we are striving and which will be beneficial both to our planning and to industry is longer range appropriation of funds for research and development.

Another feature about the present system of funds appropriation which is a definite detriment to good planning is that appropriations are made on a fiscal year basis and final approval is frequently not known until the particular year is well advanced. We recognize the impracticability of a fixed yearly budget extending over a long period of time but it would certainly improve our long range

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The new C.A.R. performance requirements for transport airplanes represent the culmination of many years' thought and experience on the part of Government agencies and the entire aviation industry. They differ widely from previous rules, and thus must be studied and lived with before all their implications are understood.

The viewpoint of an airlines operator was given on pp. 47-50 of the January issue in an article by R. W. Ayer and F. F. Fennema.

Presented here in digest form is an airplane designer's conception of the problem.

FROM A PAPER BY

W. Bailey Oswald*

TRANSPORT DESIGN UNDER CAA RULES

(This paper will be published in full in SAE Quarterly Transactions)

SAFER flying will result from the use of transport airplanes designed to the new performance requirements of the Civil Air Regulations – and future developments will not be hindered. This is the conclusion reached by Dr. Oswald after a thorough analysis of the new regulations. He shows that:

The basic soundness of the requirements has already been proved because the few aircraft that have already been certificated under the new rules have given outstanding operation service for the past year.

*"Designing to New Transport Category Performance Requirements of Civil Air Regulations," by W. Bailey Oswald, chief of aerodynamics section, Douglas Aircraft Co., Inc., was presented at the SAE National Aeronautic Meeting, Los Angeles, Oct. 4, 1946.

The new requirements relate the performance of an airplane to the type of operation in which it will be used – as contrasted with the rather arbitrary requirements of the old regulations.

The previous regulations, for example, had a 1000-ft take-off requirement at sea level and standard take-off weight, a 65-70 mph stalling speed requirement at landing weight, and a first-minute rate of climb requirement at sea level equal to eight times the stalling speed. The related operating rules required a 50 fpm rate of climb at 1000 ft over the highest point along the route. Maximum weights were not related to length of runway by any consistent formula.

This system worked well enough until improve-

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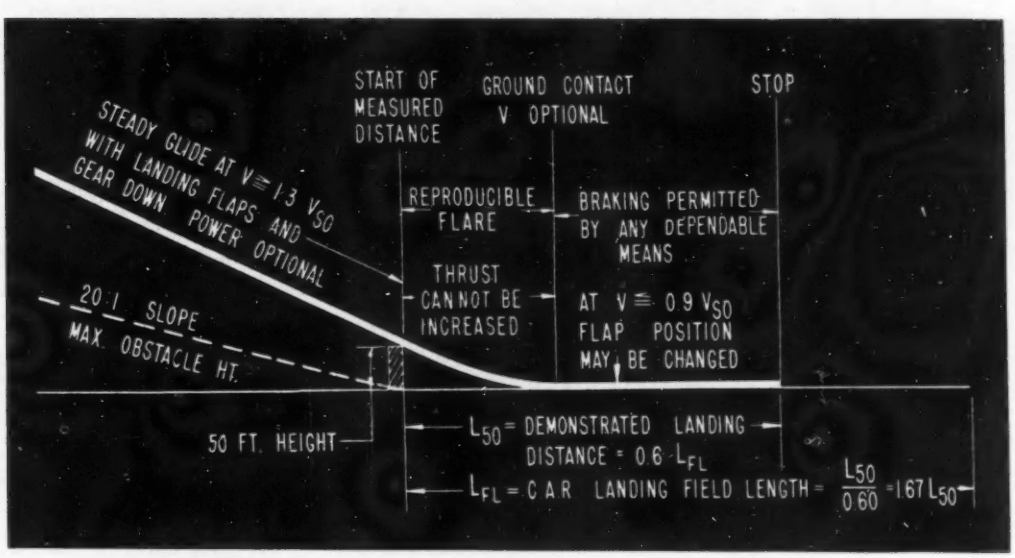
START OF MEASURED DISTANCE
GROUND CONTACT V OPTIONAL
STOP
STEADY GLIDE AT V ≧ 1.3 V$_{SO}$ WITH LANDING FLAPS AND GEAR DOWN POWER OPTIONAL
REPRODUCIBLE FLARE
BRAKING PERMITTED BY ANY DEPENDABLE MEANS
THRUST CANNOT BE INCREASED
AT V ≧ 0.9 V$_{SO}$ FLAP POSITION MAY BE CHANGED
20:1 SLOPE
MAX. OBSTACLE HT.
50 FT. HEIGHT
L$_{50}$ = DEMONSTRATED LANDING DISTANCE = 0.6 L$_{FL}$
L$_{FL}$ = C.A.R. LANDING FIELD LENGTH = $\frac{L_{50}}{0.60}$ = 1.67 L$_{50}$

Fig. 1 – Typical chart showing landing procedure prescribed by the transport category of the C.A.R.

(1) At the altitude of landing, the climb in this configuration using take-off power on all engines $\geqq 0.07\ V^2_{S_O}$

(2) Landing distance is determined for standard atmospheric conditions and good runway surface

STAINLESS STEEL BIDS for B

PERMITTING simple fabrication and increased payload, stainless steel truck and trailer bodies offer the designer and fleet operator greater shop and operating economies. Improved design and metal-working techniques recently introduced exploit stainless steel virtues for practical application.

With engineering advances made in the past few years, operators can be convinced of the economic desirability and advantages of adapting stainless steel to motor haulage bodies.

If the item of first cost alone were given sole consideration, nothing further could be said that would favor the selection of stainless steel metals over the more conventional types. But because conversion of so-called "dead weight" or net vehicle weight into revenue-producing payload, minimization of maintenance, up-keep, and frequency of replacement are all of major importance from the standpoint of pure economics, full consideration of the advantages of adapting stainless steel to commercial bodies is in order.

When a reduction of between 1000 and 1500 lb in weight of a conventional 28-ft semi-trailer can be accomplished by the adoption of stainless steel members, the gross added earning power of this stainless steel unit per period of time will be equal to the specific additional tonnage carried, multiplied by the prevailing revenue rate – and there are literally thousands of examples of such performance now in daily operation.

If, on the other hand, the desire should be for added body cubage, at no increase in vehicle weight over conventional types, that condition can also be satisfied on a proportional basis.

From the necessary frequency of replacement point of view, careful observation of stainless steel trailers and bodies, that have been in constant service during the past five or ten years, definitely indicates a metallic permanency almost beyond comprehension.

Units of stainless steel offer a maximum resistance to operational damages and a very marked tendency to localize impact forces. It is not unusual to see a stainless steel unit that has been wrecked almost beyond recognition in a relatively small area with the remainder of the unit fully intact and virtually in its original condition.

Removal of damaged parts can, in many cases, be accomplished by simply breaking the welds. Driving an ordinary flat chisel, with a good cutting edge, in between the welded joints will usually do the trick. If necessary, complete sections can be removed with ordinary light power hand saws fitted with special circular steel blades, or with ordinary hack saws fitted with high-speed blades.

Promiscuous use of cutting torches should be discouraged, not because they are not effective, but because if heat dissipating agencies are not

SOME DESIGN FACTS

Stainless steels referred to in this article – the 18 and 8 group – have chemical compositions within the range of 0.08 to 0.10% carbon, 18 to 20% chromium, 8 to 10% nickel, with a maximum of 0.03% phosphorus and sulphur, and 0.75% silicon.

These steels are attractive to designers as a weight-saving and size reducing material, Drew says, because of the following changes in physical properties after cold working:

	As Rolled Condition	*After Cold Working*
Tensile strength in psi	80,000 to 95,000	100,000 to 300,000
Yield point in psi	35,000 to 45,000	60,000 to 250,000
Elongation in 2 in.	55 to 60%	50 to 2%
Reduction in area	55 to 65%	65 to 30%
Brinell hardness	135 to 185	170 to 460

Since the modulus of elasticity remains fairly constant for the complete range of alloy steels, possible weight savings are nearly pro-

* Paper "Motor Haulage Bodies of Stainless Steel," by V. M. Drew, Director of Research, Fruehauf Trailer Co., was presented at the SAE National Transportation & Maintenance Meeting, Chicago, Oct. 17, 1946.

BODY WORK

EXCERPTS FROM A PAPER BY **V. M. DREW***

applied to the areas immediately adjacent to the desired cut, all of the corrosion resistant properties and much of the initial strength of the metals will be dissipated for some distance in all directions from the point where the cutting torch is applied.

After removal of the damaged part, replacement is simply a matter of over-lapping; the joining process of course being merely a reproduction of the original welds in relocated areas using the same type of welding equipment with which the original fabrication was made.

Design engineers are concerned with building a commercial body that encloses and protects the commodity in transit and – in the case of trailers – a body that carries the load. Here the body acts as a beam or bridge, supporting the load over the span between the tractor fifth wheel and the rear-axle suspension.

A design with these characteristics eliminates the necessity of a more or less conventional frame by causing the enclosing side walls to also function as a load carrying truss or girder, whose depth is automatically equal to the inside height of the body.

At present, all stainless steel trailer bodies of the stressed-panel design will be found to consist of a series of stainless steel strips corrugated lengthwise to a depth of approximately ½ in., with a spacing of approximately 1½ in. between corrugations. Sections are not only joined together to form a unit side wall panel or roof section, but are also joined to a series of upright posts or side stakes also formed from stripped steel stock into "Z" shaped post sections and to a series of light strong roof bows whose ends are joined to the uppermost end of the side stakes.

These are supplimented with a series of specially formed floor stringers or cross members of channel-shape with reverse flange edges and a series of longitudinal "hat-shaped" sections resting directly on, and attached to, the upper surface of the floor stringers or cross members, plus a formed roof cap and front end enclosure similar to the side wall panels described. These members, with customary rear and side doors as may be required, are the only essential parts required for the fabrication of the basic structure of stainless steel bodies.

Regardless of the chemical, physical, or structural factors of the material for a specific requirement, maximum values are obtainable only when connections employed are fully equal to, or greater than, the values of the sections so joined. This, of course, is also true of stainless steel.

Successful use of rivets, bolts, pins, and other similar methods of connections, must always be accompanied by a section thickness of sufficient value to at least equal the shear value of the pins or rivets themselves. Some allowance must also be made for the added weight of the necessary heads and nuts.

Certainly the most widely, if not the only successful method currently used in joining stainless steel parts in the fabrication of bodies for motor haul-

ABOUT STAINLESS STEEL

portional to permissible area reduction. The stronger the steel, the less material needed to meet a specific stress requirement. For example, a simple beam of 150,000-lb steel will weigh about one-third as much as one fabricated of 50,000-lb steel.

Naturally the lighter unit also must have thinner sectional areas. Best and most economical usage of high-strength steels centers about thin sections that must be both stable as a section and give long-time resistance to further area reduction from rusting and corrosion. Stainless steel satisfies these requirements; there are relatively few elements, acids, or acid combinations to which it is not fully resistant.

Cold working, within reasonable limits, greatly increases stainless steel strength so that sections calculated on initial strength of flat sheets or strip stock, as rolled, actually will have a substantial safety factor in the formed or finished sections.

Because of these and other essential factors, stainless steel truck and trailer bodies consist of thin-section flat stock, rolled, formed, and pressed into desired shapes and joined together in one homogeneous structure.

age, is known as the "shot-weld" method.

Equipment developed to produce "shot-weld" connections not only proportions the diameter of the weld to the thickness of the stock and the time effusion as well. It also provides a special check on the correctness of the operation by producing a recording tape in which any variance of either time or current is immediately brought to attention.

Since this type of connection does not involve the removal of any portion of the stock of the members joined, it will be obvious that individual welds may be closely grouped and of adequate numbers to insure a sound and satisfactory joint.

For connections where high stress transfer is not the basic requirement (such as the attachment of electrical wiring, interior finishes, and advertising signs) suppliers have this to say:

"No difficulty will be experienced in drilling the chromium steels if a high-speed steel drill is used and driven at about half of the speed used when drilling mild steel. 18 and 8 steel immediately hardens when drilled. Therefore, a sharp drill, ground slightly flatter than standard, cutting continuously and not too fast, will operate satisfactorily. . . ."

When the necessary holes have been provided, either conventional bolts or self-tapping screws may be used with complete satisfaction, but corrosion resistant bolts or screws are recommended.

It should also be mentioned that, in the adaption of stainless steels to commercial bodies, no consideration need be given to any protective coatings for the metals themselves on either exterior or interior locations. Surfaces may be painted, if desired for decorative purposes. Satisfactory adhesion will prevail if the metal surfaces are thoroughly cleaned and dried when paint is applied.

What then are the deterrent factors that have tended to hold wider usage of stainless steel in check? First, equipment required to work it, has been of such a nature as to require mass production with limited variations. Second, vehicles of stainless steels did not come into current commercial usage until just a few years prior to the war. During the war period, basic elements of chrome and nickel were so critical that they were unavailable for steel for commercial haulage purposes.

These handicaps and others such as obtaining and installing adequate servicing facilities soon will be overcome, allowing stainless steels to play an important part in perfecting light-weight motor haulage equipment.

TRANSPORT DESIGN

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ments not contemplated by the regulations were introduced, such as four or more engines per plane, tricycle landing gear, and highly supercharged engines, and transport flying covering a wide variety of altitudes and airports. These developments pointed toward the need for more flexible regulations.

This flexibility is now provided by regulations that integrate the performance of an airplane with the route over which it flies – and that make maximum weight dependent on the use to which the plane is to be put (along with an absolute maximum for minimum safety standards). Various emergency conditions are considered, principally that of failure of an engine.

Thus, the field length must be sufficient to permit take-off either to be continued or to be stopped in case of engine failure at any time. In landing, the airplane must be able to come to a stop from a 50-ft height within 60% of the minimum length of effective landing area. (See Fig. 1.) Maximum allowable weight for each important operating condition near the airport and en route is limited generally by rates of climb attainable in emergencies, principally when one engine is inoperative.

The regulations include no arbitrary limit on stalling speed, but the minimum rates of climb usually vary as the stalling speed squared, so that it is necessary to have either low stalling speed or a rapid increase in performance as stalling speed is raised.

The effort to combine past operating experience with needs for safety, as well as probable trends in design has resulted in regulations that are somewhat involved. Many conditions must be analyzed in designing a new airplane and much operating material must be prepared after flight tests. Thus the ingenuity of the designer is given a free hand, but his product must meet safety standards that are the stiffest yet devised for transport airplanes.

Efforts have been made toward simplification, such as the use of standard atmospheric conditions throughout, but there is still much to be done along these lines. Simplicity that is consistent with good design and with safety requirements will do much to promote progress.

WHERE DO WE STAND ON UNDER-WING FUEL?

EXCERPTS FROM A PAPER BY **H. O. OLSON***

HOW to achieve the convenience and speed of under-wing fueling without experiencing its potential hazards and penalties has been a subject of considerable study by the aircraft industry since the end of the war. Although all the problems have not yet been solved, industry cooperation in testing various "bottom-fueling" methods is aimed at standardization of the most desirable one.

It is intended in this article (1) to review the progress made in under-wing fueling in the past twelve months and (2) to forecast what has yet to be accomplished through whole hearted cooperation between the airlines, manufacturers of pumping equipment, the designers of quick disconnect fittings, developers of quantity indicator installations, the oil companies, the airport planners, and the airframe builders.

When it was first considered advisable to stay off the top of the wing, we began to think of pressure fueling through a manifold system of piping carrying the fuel to the high side of the various tanks in the center section and/or the wings of the aircraft.

It was evident from the start that a manifold system in the airplane represented a weight penalty, taking into account the tubing, the shut-off valves, the check valves and the trapped fuel. When industry began to talk in terms of 200 gpm per tank with two or more tanks being filled simultaneously, manifold systems seemed entirely impractical, so consideration was given to providing an inlet on the under side of the wing for each tank.

There was one other very important factor which plagued the exponents of under-wing or pressure fueling and which has done more to retard progress than any other obstacle. As long as tanks were filled from a filler neck on the top of the wing the man could see when the tank was full. If he failed to shut off the nozzle and the fuel did spill over the wing, at least the tank was not damaged. But if he pumped gas into a closed tank, with vent lines only large enough to carry off the displaced air, what assurance was there that he would not overfill the tank, burst its seams, and spill fuel down into the bowels of the aircraft, setting the stage for a possible three-alarm fire?

With the introduction of integral wing tanks, such an accident would become much more serious. Its seriousness was significant enough to prompt some operators to say they would not rely on "any mechanical device" to stop the flow of fuel when the tank was full. Under such a restriction there is, even today, no answer to the problem.

Standard Fitting Evolved

A year ago the National Aircraft Standards Committee had already set up a committee to coordinate the standardization of an under-wing fueling quick disconnect fitting – Project Number P-305. The persistent, determined, and intelligent course of action taken by this committee resulted in the establishment of basic principles which permitted the industry to proceed with development work. The NASC committee formulated a specification for a disconnect fitting which was provisionally accepted by the Air Transport Association Engineering Committee. Certain fundamentals were agreed upon:

1. The rate of flow shall be 200 gpm through a 2½ in. orifice with a static pressure of not more than 5 psi;
2. The fitting shall be of the bayonet type;
3. The standard hose element shall be designed to operate the standard tank element interchangeability; i.e. the hose element of any manufacturer must operate the standard tank element valve mechanism.

Drawings were prepared giving accurate dimensional data which would insure standardization and interchangeability.

The airframe manufacturers now had to determine what measures needed to be taken in their airplane to provide for the fueling operations envisioned in the above mentioned specification. What structural problems would be involved in mounting the fitting? Would an auxiliary vent line have to be provided for releasing the air displaced by the fuel entering at 200 gpm? What problems would multiple bladder cell type tanks present? And, undoubtedly the most serious question of all, what

*Paper "Under-Wing Fueling," by H. O. Olson, Servicing Equipment Engineer, Douglas Aircraft Co., Inc., was presented at the SAE National Air Transport Engineering Meeting, Chicago, Dec. 4, 1946.

could be provided to assure against damaging the airplane by over-filling?

Last summer a quick disconnect fitting, both hose and tank elements, designed according to the NASC specification, was available. Using this fitting and a newly developed pumping unit, Douglas started its test program. Fig. 1 shows the underwing fueling filler and relief valve assembly.

An integral tank section of a DC-4 center wing assembly was supported in the static ground attitude. The in-the-tank elements of the disconnect fittings were mounted on the inboard removable stress panels of each tank. Pumping equipment was a hydroelectronically controlled unit with a rated capacity of 200 gpm embodying the collapsed or dry-hose feature. One hundred octane fuel was used. A series of pumping runs showed a consistent delivery of 230 gpm with an orifice pressure of 5 psi.

With normal fuel tank vent lines the static pressure in the tank during the run was 1.0 psi, showing that auxiliary vents are not needed for high volume fueling operations. The column of fuel hit the top of the tank with no great force but created an agitation which continued until the low end of the tank was practically filled. By placing a simple baffle plate on the tank element the stream was deflected horizontally in all directions and agitation was stopped after about 25 gal of fuel had entered the tank.

For test purposes a liquidometer assembly was reworked to function as a circuit-breaker and was installed on the high end of the inboard tank and wired into the relay switch of the pump motor electrical system. When the fuel reaches the expansion area level, it actuates the float and breaks the relay circuit which stops the pump motor. Repetitive runs showed consistent shut-off control.

Fuel flow may be controlled by the lever on the hose element of the fitting. Once the valve is opened manually and the fuel is discharging, the operator may let go of the handle. The pumping force holds the spring loaded valve open with a 5 psi increase in orifice pressure and a delivery drop from 230 to 220 gpm. When the pumping system is stopped the valve closes automatically with no snap or jolt. The valve can be closed against the pumping force, throttling the fuel flow to any desired rate. The tanks can be defueled at the rate of 35 gpm through the collapsible hose feature of the pump.

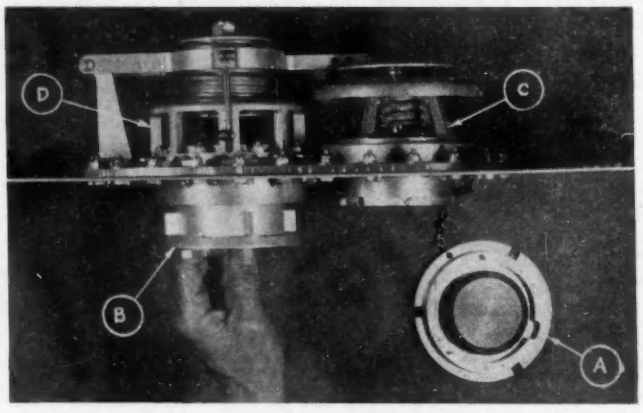

Fig. 1 – Fueling filler and relief valve assembly for under-wing fueling. (A) is the dust cap covering tank element of the quick disconnect fitting; (B) is the relief valve that has a cross bar for holding the dust cap in locked position; (C) is the tank element housing, and (D) the relief valve housing. The relief valve has been manually opened to permit removal of the dust cap

The hydro-electronic control feature of the pump offers many conveniences which aid in safe fueling operations. The electronic control utilizes the inherent static ground current. Before the pump will discharge fuel, the airplane and pump must be grounded and the circuit completed by the static wire in the hose running from pump to plane. A small switch located at the connector fitting may be used by the operator to open or close the circuit. When the circuit is open a valve system on the pump remains in a vacuumizing position which collapses the hose. Any malfunction of the control system will create a "fail safe" condition.

Much has yet to be accomplished in our test program. An important phase of the remaining test program will be the development of a "rupture plate," designed to burst before there can be any structural damage in the event of overfilling. Occurrence of just one "accident" wherein a wing tank is ruptured by overfilling, with the possible resultant fire, might represent a loss far greater than the benefit derived from the convenience of underwing fueling.

It was stated earlier that a mechanical safety shut-off device was not acceptable to some operators. Without it, the person handling the equipment would be the only control factor. Unfortunately, we have not as yet found an infallible man. Must we then disqualify the whole idea of under-wing fueling? Or is there a compromise?

Let us consider some of the safety proposals which are being investigated. The following four safety control factors appear to give reasonable assurance of "accident-free" operation:

1. The selection of the man to operate the equipment: The job is important and much care must be taken in the selection of this personnel. No matter how good the equipment, it takes brains to run it. Pumping equipment can be made "fool-proof" but not "damn foolproof."
2. The pre-set meter: The pre-set meter has been developed to a high degree of reliability. Being an integral part of the pumping unit, it may be used as an automatic shut-off. The fueling operator will have two sets of figures to work with – the quantities of fuel already in each tank and the amounts required for the next flight. The capacity of each tank for a given model will be part of the working knowl-

edge of the job assignment. Simple subtraction will determine how much is to be pumped into each tank. The meter is set to that quantity and the pump started. When the pre-determined amount has been delivered the pump ceases to discharge.

3. Safety shut-off: A float-type circuit breaker was mentioned earlier as a safety shut-off device which would stop the pumping system if the liquid rose above the expansion level of the tank. Any one of the following irregularities will result in over-filling:
   (a) There might be more fuel in a given tank than the airplane fuel gauge system indicates.
   (b) The operator might err in his subtraction or fail to pre-set the meter accurately.
   (c) The meter shut-off might fail.

   The circuit-breaker, mounted at the top of the tank, is wired to a receptacle on the bottom surface of the wing near the disconnect fitting. An extension cord from the control system of the pump plugs into the receptacle. It will be impossible to start the pump until the extension cord is connected.

   The float is adjusted to break the control circuit at the moment the liquid reaches the level of the expansion area of the tank. It must be remembered that a safety device ceases to be a safety device if it is used as a regular control. There may be a tendency on the part of the operator, when his orders are to "fill-up," to not bother about his subtraction procedure, but just over-set the meter and let the circuit-breaker safety device become a routine shut-off unit.
4. The rupture plate: In case the circuit breaker safety device should fail to function, a rupture plate is being considered to avoid damaging the tank. This plate will most likely be located on the top of the wing at the high side of the tank. It will be designed to burst, providing the opening is large enough to discharge fuel as fast as it is being pumped. Calculations indicate that when the tank becomes full, pressures will increase from 1.0 psi to 40.0 psi in 1/3 of a second. The rupture plate will have to burst before the pressures reach design limitations of the tank.

A year ago the statement was made that "It is almost a 100% certainty that 'under-wing' fueling will be heavy; complexity of equipment will insure this." The question was put: "How much will the customer care to sacrifice to obtain the gains offered by under-wing fueling?" The question hasn't been answered yet.

But today it appears that the installation will not be so heavy after all. The tank element of the disconnect fitting used in tests, including its mounting, dust cap, and cover plate will weigh about 3 lb; the float circuit breaker need weigh no more than ½ lb; the rupture plate possibly 1½ lb, a total of 5 lb per tank. When new pumping equipment is universally available the present filler-neck casting, strainer, and cap may be removed thereby cutting out about 2 lb. But 5 lb per tank would seem to be a fair estimate for the time being.

If a tone of optimism toward early general adoption of under-wing fueling has been conveyed, it should not be concluded that all the problems have been solved. Far from it. Fuel gauge systems must be perfected to the highest possible point of reliability. Operators are still "sticking" the tanks to be sure of their fuel loads. Provisions should be made for plugging into the quantity gauge system from under-wing with indicators which are part of the ground equipment, making it possible to check tank quantities without having to go to the cockpit or energize the airplane's electrical system. This would aid greatly in the safe operation of under-wing fueling equipment.

Adapting Planes in Service

Coinciding with the problem of provisioning high volume pumping units will be the problem of equipping airplanes already in service with provisions for under-wing fueling. This job would be greatly facilitated by airplane manufacturers making available conversion kits and complete instructions for the change. Otherwise the transition period from present over-wing fueling to under-wing fueling will be very long.

Planning of new airports as well as the revamping of present facilities must show a realistic approach to the provisioning of underground fuel supply systems. Fueling docks should be part of passenger ramp equipment to accommodate turn-about or through scheduled planes. More remotely located fueling docks for planes being readied for originating schedules might also be provided. This realistic approach is going to force the issue of comingling of products to avoid the uneconomical duplication of storage and supply systems.

Most of the progress of the past year in development of under-wing fueling was made possible by a decision on the part of those who are most directly concerned – the airlines. The decision was embodied in the specification standardizing the under-wing fueling connectors. It is now time to make another decision: What safety device or devices for protection against over-filling will be acceptable? Test programs being conducted by the airframe manufacturers will present the merits of various methods. NASC and ATA can again develop a specification which will standardize the most desirable method. It is hoped definite action will be directed toward this achievement.

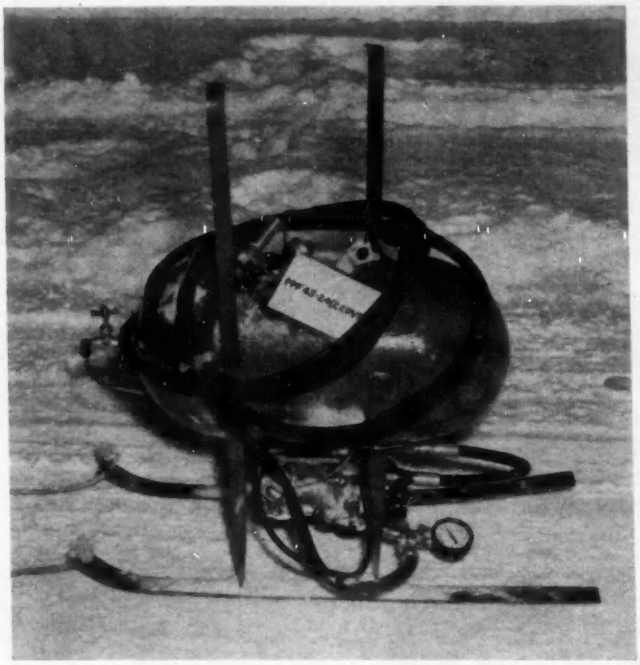

Fig. 1 – Experimental kit for use with highly volatile liquid fuels – used in Air Materiel Command cold-starting tests in Alaska during 1945-1946

COLD WEATHER No Longer

AIRCRAFT engines can now be started and operated successfully in cold climates with the help of procedures and equipment that have reached the practical stage, thanks to the combined persistence of Army, Navy, and industry. Future investigation will be directed mainly toward simplifying these procedures and equipment.

It is no longer necessary to use the method of keeping airplanes on a 24-hr alert that was followed at Anchorage in 1941-1942 when the Japs attacked the Aleutians. In cold weather all the engines in each airplane had to be started and warmed up every few hours, which led to battery troubles, starter failures, fouled spark plugs, oil dilution difficulties, and other maintenance difficulties.

Present day specifications of both Army and Navy require aircraft engines to start at the extremely low temperature of −67 F when cranked at 40 rpm for only 1 min. The temperatures usually encountered in Alaska are in the range −20 F to −50 F.

Navy Experience

Need for simplification is especially felt by the Navy because of the limited space on ships and carriers.

To attain this end it has conducted many laboratory cold-starting tests since the first ones were run in 1927. It has frequently sent ships and carriers on cold-weather cruises and has had flying boat squadrons operating in Alaskan, New England, and Greenland waters on various occasions.

Forney discusses the problems encountered by the Navy in starting aircraft engines as follows:

1. Starters: Navy investigations showed that cranking speed of starters could be reduced from the former figure of 60 rpm to 25 rpm without reduction in starter reliability – a change that brought starter weight down from 45 lb to only 26 lb.

The Navy favors the direct cranking electric starter over all other types developed to date because its longer cranking period enables the pilot to adjust engine conditions if they are not exactly right when the start is first attempted.

2. Source of power: The tremendous drain that cold starting has on batteries has made it necessary for batteries of increased capacity at high rates of discharge to be developed, even at the expense of battery life. Until such a battery is developed, the Navy has to be content with the use of ground auxiliary powerplants to furnish power for low-temperature starting. In the meantime the Navy is using a light, easily handled electric unit developed by the AAF. The Navy is also working on the development of a battery charger that can be used on deck to charge the batteries of several aircraft simultaneously.

3. Heaters: Engine heaters are fast becoming obsolete on aircraft carriers because of the difficulties and inconvenience attending their use, and because the temperatures encountered at sea are rarely low enough to require them.

A plywood cowling entrance cover has proved effective in preventing blowing snow from blocking the passages of the engine airscoops.

4. Insulation: The only ignition system trouble reported by the Navy has been caused by the condensation of moisture on the spark plugs, which in some cases freezes and shorts out the plugs. The best preventive is to obtain a start before ice

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* "Cold-Weather Operation of Aircraft Powerplants by United States Navy," by A. K. Forney, Powerplant Division, Bureau of Aeronautics; "Aircraft-Engine Starting Tests and Experiences in the Arctic," by William Weitzen and Robert G. Dunn, Powerplant Laboratory, Air Materiel Command (to be published in full in SAE Quarterly Transactions); "Cold-Starting Characteristics of Cyclone Engine," by George A. Bleyle, Wright Aeronautical Corp. (to be published in full in SAE Quarterly Transactions). All three papers presented at a symposium on cold-weather operation, SAE Annual Meeting, Detroit, Jan. 8, 1947.

BASED ON PAPERS BY A. K. Forney, William Weitzen and Robert G. Dunn and George A. Bleyle*

Feared for Aircraft

has time to collect. An attempt to use alcohol in the priming system to melt the ice resulted in a mixture collecting on the plugs that was worse than the original water or ice alone.

5. Oil dilution: Although oil dilution is required for all combat aircraft, it is something the Navy would like to eliminate. It adds 5 lb per engine to each aircraft, although it is used only a small part of the time.

6. Priming: Practically all Naval aircraft have been equipped with solenoid primers because they give continuous priming during starting, the primer switch can be mounted next to the starter switch in such a manner that both can be operated simultaneously with one hand, and, since solenoid primers are mounted on the carburetor, the fuel line into the pilot's cockpit required by the hand primer is eliminated.

Various types of priming nozzles or jets have been tested by the Navy but no radical improvements have been made for several years.

The Navy has discontinued the use of special starting fuels because too much bulky special equipment was needed, special storing and handling provisions would be required on carriers, and it introduced the problem of supplying a special fuel to Naval aircraft activities.

Instead, the Navy has directed its efforts toward improvement of priming systems using gasoline, as it is convinced that the development of priming systems has lagged far behind engine development in the past two years.

In some cases engines have been received by the Navy with priming jet so buried that the spray impinged on the walls of the priming jet bosses or engine induction system to such an extent that little or no spray ever reached the cylinders.

Icing in Flight

The so-called alternate-air system is being used by the Navy to take care of carburetor induction system icing – the major cold-weather problem encountered in flight.

This system consists of a two-position door in the engine induction system with a control manually operated by the pilot. The normal position of the door is "direct," that is, ram air from the induction system scoop goes directly to the carburetor. When icing conditions are expected, the pilot changes the door to the alternate-air position. This closes off the air from the induction system scoop and permits air taken from a protected location usually behind the cylinders or in the accessory compartment to enter the carburetor. The air taken in when in this latter position has been heated slightly and further dried by mechanical separation of moisture by making the air change direction or velocity.

The most important point to remember in the

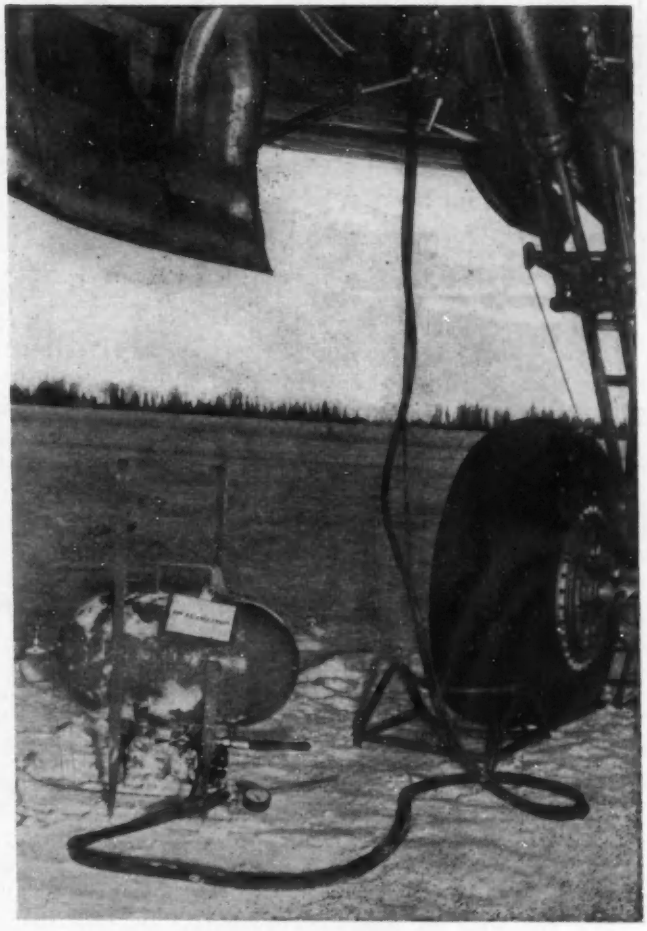


Fig. 2 – Cold-starting kit attached and ready for use with C-54 aircraft

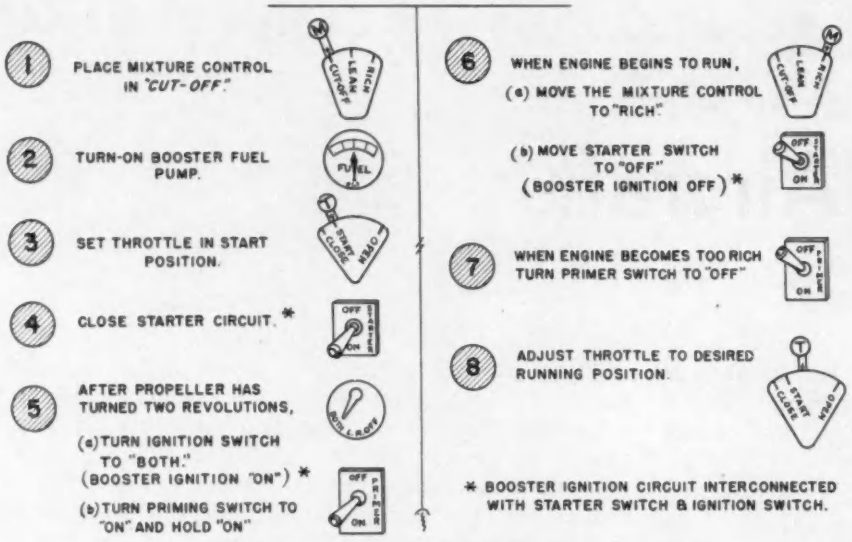

1 PLACE MIXTURE CONTROL IN "CUT-OFF."
2 TURN-ON BOOSTER FUEL PUMP.
3 SET THROTTLE IN START POSITION.
4 CLOSE STARTER CIRCUIT. *
5 AFTER PROPELLER HAS TURNED TWO REVOLUTIONS,
(a) TURN IGNITION SWITCH TO "BOTH." (BOOSTER IGNITION "ON") *
(b) TURN PRIMING SWITCH TO "ON" AND HOLD "ON"
6 WHEN ENGINE BEGINS TO RUN,
(a) MOVE THE MIXTURE CONTROL TO "RICH."
(b) MOVE STARTER SWITCH TO "OFF" (BOOSTER IGNITION OFF) *
7 WHEN ENGINE BECOMES TOO RICH TURN PRIMER SWITCH TO "OFF"
8 ADJUST THROTTLE TO DESIRED RUNNING POSITION.
* BOOSTER IGNITION CIRCUIT INTERCONNECTED WITH STARTER SWITCH & IGNITION SWITCH.

Fig. 3 – Starting procedure with temperature-controlled priming

use of the alternate-air system is that the change to alternate air *must* be made either prior to encountering icing conditions or immediately thereafter. There is not sufficient heat rise in such a system to melt out a deposit of ice from the carburetor. The system has no intermediate position between direct and alternate air. To provide such a position would result in aggravating the icing under certain conditions.

Forney reports that in no case where it has been properly employed and correctly constructed so that there is no leakage of direct air in the alternate position has the alternate-air system been unsatisfactory.

Army Experience

The Army attitude, as reported by Weitzen and Dunn is that it is willing to put up with a certain amount of special fuel and equipment.

The Army, for instance, would like just as much as the Navy to see the development of a synthetic lubricating oil that has a pour point so low that oil dilution would be unnecessary. Meanwhile, the Army is willing to accept oil dilution as absolutely necessary for safe operation in the Arctic. The Army authors claim that it is basically sound and in fact lengthens engine life under such operating conditions.

They say further that they can find no evidence of a single engine failure that can be attributed to the *proper* use of oil dilution over the five years that Air Matériel Command has been making tests in Alaska. They feel that many engine failures are blamed on oil dilution without any basis whatever, for the simple reason that oil dilution is an easy item to criticize.

The authors do, however, mention three problems that have perplexed the Army in connection with oil dilution:

1. Lack of direct control by operating personnel over the results desired.

2. Poor segregation characteristics of some oil tank designs.

3. Dependence on weather predictions for the anticipated temperature at the time of the next start.

To help solve the first problem the Army would like a dilution indicator that would indicate to operating personnel what percentage of dilution is being obtained during the dilution period prior to engine shutdown. The present method uses time as the control factor to obtain a definite per cent of dilution based on the anticipated temperature for the next start. This indirect control method, plus the indefinite segregation characteristics of some oil tanks, plus the unpredictable fluctuations in weather prior to the next start often adversely affect dilution and account in a large measure for the variations in cranking speed that are obtained.

Like the Navy, they do agree that heaters could well be eliminated. Heating the engine, they point out, will make it crankable so that it will start easily, but it does not customarily thaw out oil lines, tanks, and coolers, so that, even after an hour of heat application, oil flow is questionable and certainly not satisfactory.

Unlike the Navy, however, the Army recommends the use of special fuels, suggesting that normal butane be used until improved priming systems and starting techniques make it possible to use fuels with a vapor pressure of, say, 25 psi.

The Army approach to the problem has been to develop cold-starting kits that provide all the special equipment needed. An experimental kit used with highly volatile fuels is shown in Fig. 1. Fig. 2 shows the kit attached to a C-54 plane.

Cold-Starting Procedure

A plea was made by Bleyle for a reduction in the present multiple method of starting to a single procedure in which the throttle is set at one position for all temperatures and the primer quantity is automatically controlled by temperature, as shown in Fig. 3.

If the primer flow is not controlled automatically, then an additional step is needed and should be inserted between steps Nos. 2 and 3, namely, to set the primer flow rate with respect to the starting temperature.

CRANKSHAFT BENDING VIBRATION

Analyzed for Low-Horsepower Aircraft Engines

BASED ON A PAPER BY **E. Forest Critchlow and W. T. Bean, Jr.***

(This paper will be published in full in SAE Quarterly Transactions)

IMPROPER evaluation of bending vibration during endurance testing is the cause of most of the recent crankshaft failures in low-horsepower engines that have occurred in flight.

An analytical and experimental investigation of two crankshafts that had been breaking in service – one for an opposed and the other for a radial engine – indicates that the trouble stems from confining the endurance tests to 4-bladed club propellers. The bending vibration characteristics of the crankshaft-club-propeller combination can differ widely from the characteristics of the crankshaft-flight-propeller system, so that no amount of endurance testing with the former combination will indicate whether a particular crankshaft is properly designed.

The answer seems to be to supplement the usual endurance tests using a club propeller with tests using the actual flight propeller – a procedure that has been avoided in the past because of the necessity of making an expensive and time-consuming strain-gage installation, especially when the service record of the engine did not seem to justify such an extensive testing program.

Types of Bending Vibration

Forced bending vibration (that is, vibration caused by the gas pressure) can lead to failure of crankshafts for both opposed and radial engines. Resonant bending vibration can cause failure of crankshafts for radial engines, but it is extremely unlikely to cause the crankshaft for an opposed engine to fail. In other words, if the opposed-engine crankshaft is improperly designed, it will be so flexible that it will fail because of the vibrations set up by the gas pressure before resonance has a chance to set in.

Both types of vibration were studied to see if simpler methods of detecting them could be found.

Forced Bending Vibration

The crankshaft of a certain 471 cu in., 6-cyl opposed aircraft engine had failed, it was believed, as the result of forced vibration, so this crankshaft was studied from this point of view.

The analysis was confined to the area around

Crankshaft bending vibration problems have been plaguing low-horsepower aircraft-engine designers for some time.

Torsional vibration has been studied extensively in recent years and is now well understood by engineers, the authors say, but the more complex bending vibration problem has been given insufficient attention, despite the fact that service records indicate crankshaft failures are often caused by this type of vibration.

The seriousness of bending vibration led the CAA to cooperate with Continental Aviation & Engineering Corp. in evolving a method of detecting it during endurance testing and prior to flight tests and CAA approval.

The result of this cooperative effort was a paper that presents a new approach to the problem. The accompanying story is a brief report of this article, which will later be published in full in SAE *Quarterly* Transactions.

*"Crankshaft Bending Vibration," by E. Forest Critchlow, Civil Aeronautics Administration, and W. T. Bean, Jr., Continental Aviation & Engineering Corp., was presented at the SAE Annual Meeting, Detroit, Jan. 6, 1947.

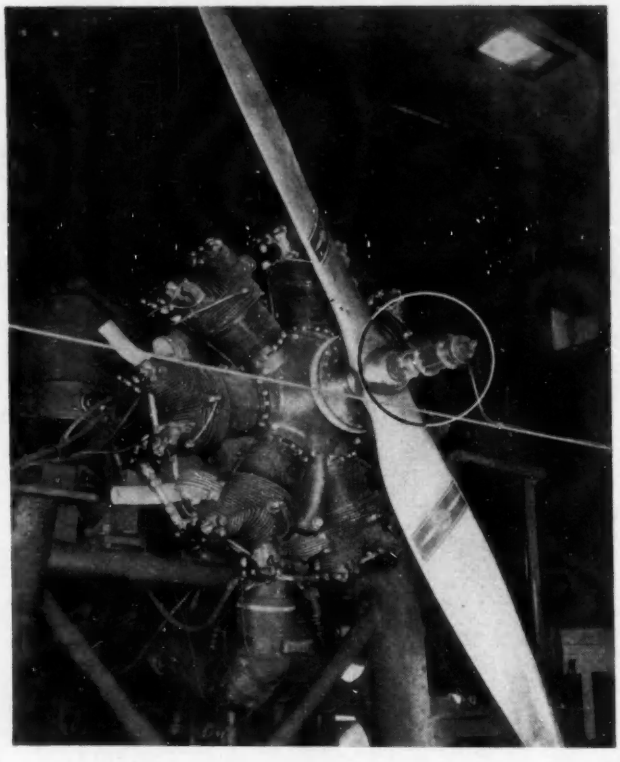


Fig. 1 – Experimental pickup used in evaluating crankshaft bending vibration
Pickup is mounted on propeller nut

a lightening hole in the crankcheek where the failure had occurred.

Static tests of the crankshaft mounted in its crankcase indicated that the crankshaft should be considered as fixed at the center of its main bearing supports. This assumption appears to be closer to the actual condition than the usual one of pin-ended joints, and should probably be used in the design of future opposed-engine crankshafts with plain bearings.

Evaluation of the stress concentration in the crankcheek under forced bending vibration gave the following maximum crankshaft stresses:

Nominal Crankcheek Stress, psi.....	10,200
Stress at Crankcheek Hole, psi.....	23,200
Crankpin Fillet Stress, psi.....	42,400

These figures check quite well with those obtained experimentally by means of four strain gages cemented close to the crankcheek hole, showing that the assumption of forced vibration was correct.

Resonant Bending Vibration

A study was also made of a 670 cu in., 7-cyl radial engine that had been having crankshaft failures with certain propellers. Since the engine had a good service record with some propellers, it seemed that the failures might be caused by excessive bending resonance. This assumption was confirmed by flight tests and also by test-stand experience with strain gages.

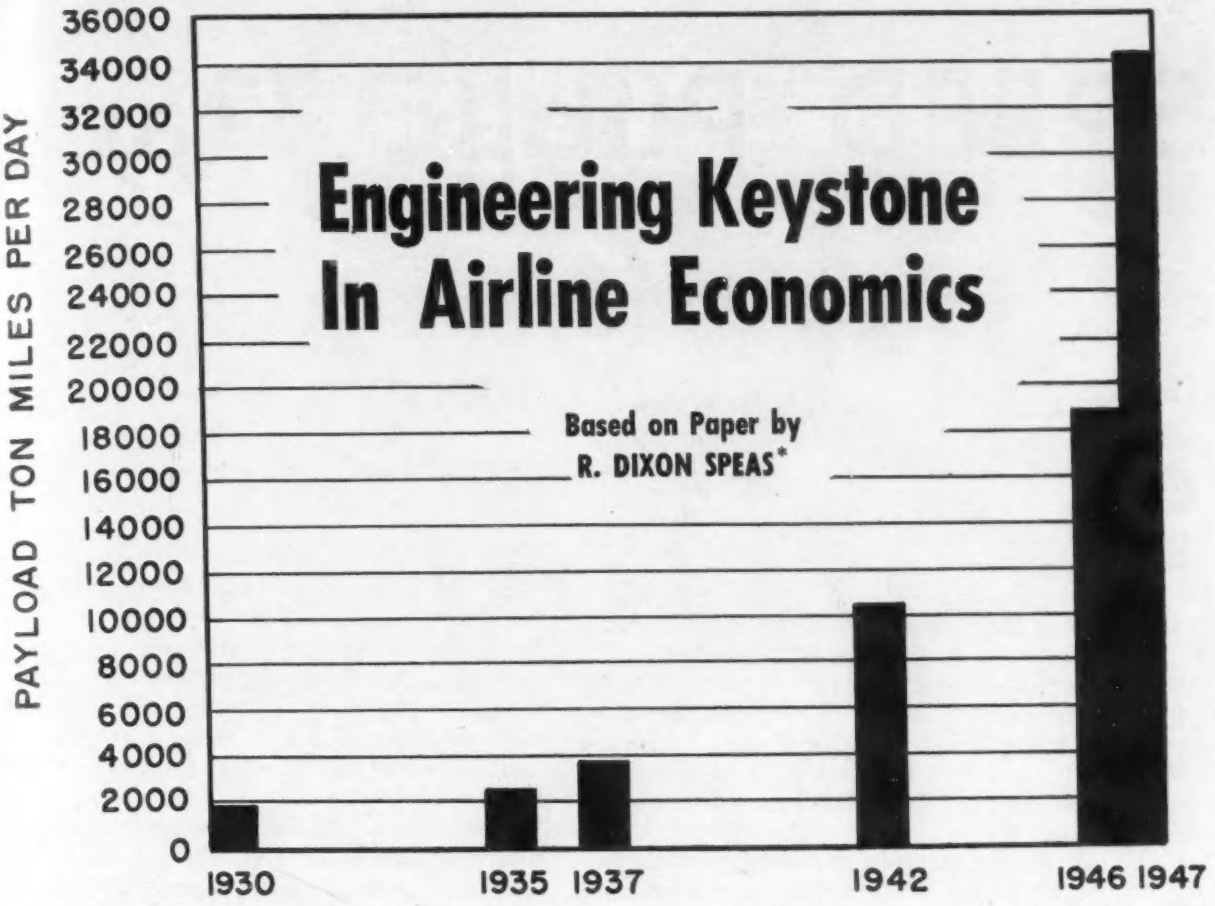
It was found that the natural resonant frequency of the system could actually be changed by varying the propeller installation position relative to the crankthrow. Due to the large number of installations involved, placards were placed on airplanes having certain combinations of engine and propeller, warning the pilot not to fly for extended periods at the critical speeds. The restricted speeds were located out of the normal operating range of the engine, so that the pilot was not particularly inconvenienced.

The problem of resonant vibration divided itself into two parts, namely, calculating the natural frequency of the crankshaft system, and determining the bending characteristics of the crankshaft with the flight propeller.

The crankshaft is mounted on ball and roller bearings, so the method of determining natural frequency was based on the assumption of a multi-span beam with pin-ended joints, as compared with the fixed ends assumed for the opposed-engine crankshaft with plain bearings. Actual frequencies as measured in flight justified this theory.

In process of development is a simple pickup that is expected to be of great help in evaluating new crankshaft-propeller combinations. (See Fig. 1.) The pickup is simply attached to the propeller nut, the engine run through its range of speeds, and the resonant speeds noted. Later, the engine can be run at the critical conditions long enough to see if the crankshaft will fail.

Certain difficulties are still being experienced with the instrument, such as keeping it in place at the resonant condition, but satisfactory correlation is being obtained with strain-gage signals, and it is felt that when it is completely developed it will simplify future bending vibration studies, so that a test for bending vibration can be made as routine as those now conducted to determine torsional vibration characteristics.



(This paper will be published in full in SAE Quarterly Transactions)

DOMINANT factor in determining airline leadership tomorrow will be engineering management planning today to fly the most payload per dollar of operational cost.

Combining economics with airline engineering, Speas develops a working formula for evaluating income potential of payload weight. How much each pound of weight means in dollars of revenue is one important phase of this overall cost-engineering study.

One pound may vary in value from a few cents to $2,000 for one airplane during a year of airline service, depending on the operation involved. But weight-saving without weight-studying can conceivably reduce, rather than increase, revenue. Determining how many dollars each pound is worth involves an analysis of a number of factors for each particular operation.

For example, flight operations at maximum allowable gross weight indicate high weight valuation. But whenever an airliner passenger allowance, based on pre-planned load distribution, is limited to less than the plane's passenger capacity, revenue is penalized. Even if passenger capacity is sold out, a flight might lose revenue if cargo were refused because of gross weight restrictions.

Often payload is refused on a weight basis because the flight was sold out sometime before departure. Yet the airplane takes off with less than maximum gross weight because of "no-show" passengers or cargo. If the "no-show" percentage can be determined for the particular operation, a portion of it can be sold as payload, increasing total revenue weight carried.

How much each marginal pound is worth in terms of the type of payload carried also is an important consideration in striving for maximum payload-miles per dollar. Averages for 1945 show that passengers bring a revenue of 0.024¢ per lb-mile, mail brings 0.026¢, and cargo 0.032¢.

Sometimes a few pounds can be worth many times its weight. Consider the case where a 200-lb mail sack was left behind because only 190 lb was available according to maximum allowable gross weight. Each of those 10 lb the operator was shy is worth 20 times the normal revenue-value per pound in this case.

Analyzing these and other factors will provide each operator with the data to apply in the for-

concluded on page 52

*Paper "Cost Aspects of Airline Policies and Procedures," by R. D. Speas, director of engineering and maintenance of the Contract Air Cargo Division, American Airlines, Inc., was presented at SAE Summer Meeting, June 6, 1946.

SPEED Public Transit

FROM A PAPER BY

CHARLES GUERNSEY*

(This paper will be printed in full in SAE Quarterly Transactions.)

MUNICIPALITIES concerned with growing traffic congestion are beginning to realize that the basic problem is movement of vehicles, not passengers. The modern trolley coaches stand out as the public transportation vehicle that will ease traffic tie-ups and at the same time offer advantages to the passenger, operator, real estate owner, and merchant.

The average automobile carries 1.7 seated passengers as against 44 in the trolley coach or large gasoline bus. Considering the necessary headway in a traffic lane, the automobile occupies 25 times more street space than the large public carrier. Obviously congestion stems from the number of vehicles involved rather than the number of passengers.

The trolley coach ranks ahead of other public vehicles in passenger appeal because it is quiet, fast, smooth in acceleration and braking, well-lighted, well-heated, and free from objectionable odors. A poll of patrons of the Columbus & Southern Ohio Electric Co. indicated that 69% of the riders preferred trolley coaches to street cars or gasoline buses.

Operators favor the trolley coach because of simplicity of the working apparatus and greater reliability in service. A check with a number of operators revealed that trolley coaches have completed an average of 97.8% of scheduled mileage as against 84.6% for gasoline buses. Unlimited power available permits the trolley coach to speed up schedules within its range of application. Although initially they cost more than a bus, fewer trolley coaches can render the same service because of higher schedule speed and less time out for maintenance.

Trolley coach life is limited by obsolescence rather than by mechanical deterioration since there is relatively little wear of parts. Depreciation is spread over ten years compared to six years for motor coaches. Trolley coaches are safer too. Records show that they operate twice the number of miles without accident as does the street car. They combine some of the better features of both the street car and the bus.

Like the bus, the trolley coach is adapted to curb loading, running around slower traffic, or making limited detours around obstructions. Presence of overhead lines – as with street cars – assures merchants, residents, and property owners of route permanency.

Operating cost-per-passenger-mile is a salient factor facing transit system operators in selection of vehicle type. Biggest cost item today is labor – driver's wages and maintenance cost. For this reason, larger capacity vehicles, such as trolley coaches, offer lowest seat-per-mile costs.

Fig. 1 indicates types of service best handled by

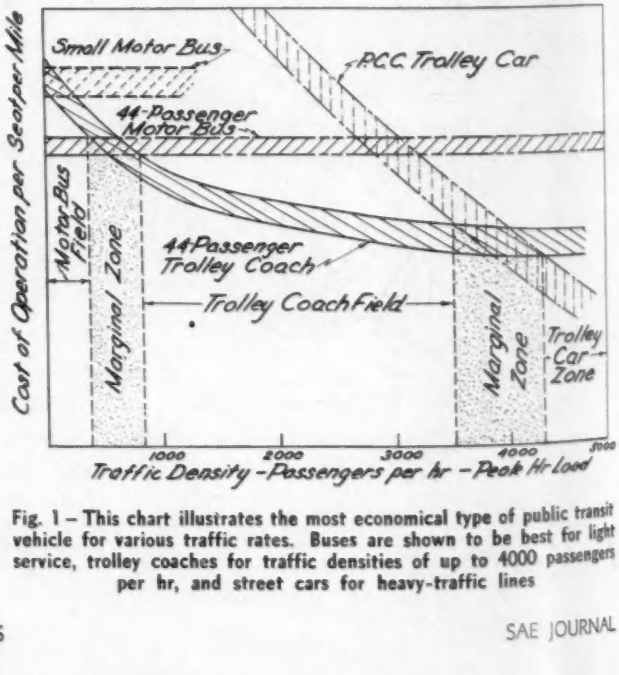


Fig. 1 – This chart illustrates the most economical type of public transit vehicle for various traffic rates. Buses are shown to be best for light service, trolley coaches for traffic densities of up to 4000 passengers per hr, and street cars for heavy-traffic lines

* Paper "The Place of the Trolley Coach in the Modern Transit System," by Charles Guernsey, vice-president, Marmon-Herrington Co., Inc., was presented at the SAE Detroit Section, Nov. 4, 1946.

with TROLLEY COACH

various types of public transit vehicles and the relative operating cost-per-seat-mile of each. It shows that bus cost-per-seat-mile remains fairly uniform regardless of the fleet size. Investment in vehicles, garages, and shops varies directly with the number of vehicles or the number of seats.

Cost-per-seat-mile is shown to be higher for smaller buses because principal cost items such as driver's wages are independent of vehicle size. But with a given size bus, cost is independent of traffic density on the line.

With the trolley coach, and even more so with the street car, overhead lines, and substations represent a large part of the capital investment. Since capital charges must be amortized over the number of vehicles using these facilities, cost-per-seat-mile for these vehicles decreases as traffic density or service frequency increases.

Optimum Range

From Fig. 1 it is seen that the trolley coach is most practical and economical on lines with a maximum density of about 4000 passengers per hr. Light-traffic lines are best served by buses and dense lines by street cars. Trolley coaches can furnish the backbone of service in cities of from 75,000 to 500,000 population.

From the standpoint of operating cost *alone,* the trolley coach is not justified for the light or very heavy types of service; but other factors must be taken into consideration. However, in its range, trolley coach operating costs are lower than those for any other types of vehicle. Cost gain-per-mile is said to be 6¢ over street cars and 3¢ over buses.

Values shown in Fig. 1 presuppose that full capital investment required for the operation has been properly allocated to each vehicle involved. Circumstances wherein the street car track is still in good condition or existing trolley coach substations already have been written off alter the picture considerably. Other factors such as power costs, fuel and lubricant prices, and paving conditions also have a considerable bearing on transit system selection.

If a trolley-coach system is chosen, influence of vehicle size and weight on operating costs should be studied. Trolley coaches vary in weight from 17,000 lb to 22,000 lb, depending on the type of structure and materials used. Too heavy a vehicle can swell operating costs due to parasite weight.

For example, in typical service making eight stops per hr, a 17,250-lb coach with its load consumes ½ kw-hr less per mile than does a 21,000-lb vehicle. At average rates, this amounts to ½¢ per mile and adds up to $2,500 during normal life expectancy. Assuming that a tire cost of about 0.15¢ per mile is saved because of the lower weight – an additional $750 – a total of $3,250 will be realized in the vehicle's life because of the 3750-lb weight difference.

Although each type of vehicle – street car, bus, and trolley coach – has its own group of staunch advocates, the best transportation system will use all types of available equipment as dictated by conditions to be met.

Rate Oil

FLIGHT-testing engine oils proved to be a useful tool in rating new lubricants aimed at longer aircraft engine life. While small-engine laboratory tests permit ultra-scientific control of variables, this proof-of-the-pudding-is-in-the-eating approach offers the final criterion in performance.

Four series of tests conducted over a four-year period (results of which are shown in the accompanying charts) point to these general conclusions:

1. Premium quality aviation oils essentially are similar in their ability to lubricate aircraft engines adequately;

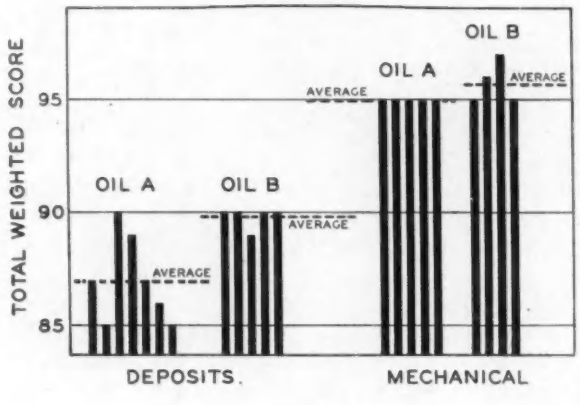
2. Differences in their ability to keep down engine deposits can be detected between different premium oils;

3. Detergent-dispersant oils tested to date show no appreciable improvement over high-quality straight mineral oils in reducing engine deposits.

This work also showed that in straight mineral oils, little if any improvement can be expected from further crude oil selection or refining methods.

In low cruising power with infrequent landings and take-offs, detergent oils will not show any improvements over straight mineral oils; under high cruising power for long flights, detergent oils offer marked improvements in ring zone deposits. This same advantage is available with detergent oils in low cruising power for flights of 1 hr or shorter; with detergents in high cruising power for short flights, considerable improvement in ring zone cleanliness over straight mineral oils is noted.

In all these tests – organized around routine airline operation – a reference oil was operated under same conditions as the test oil so that direct comparison was possible. Criteria for conclusions on each oil were based on freedom from operational difficulties (attributable to oil) and inspection of engines at tear down after full overhaul. Inspections were recorded on CRC Form L-8, which per-



TEST SERIES 1

First series of tests, conducted in 1942, were to investigate the oils then marketed and some developmental products. Pan American also checked the belief that its standard oil was not satisfactory depositwise.

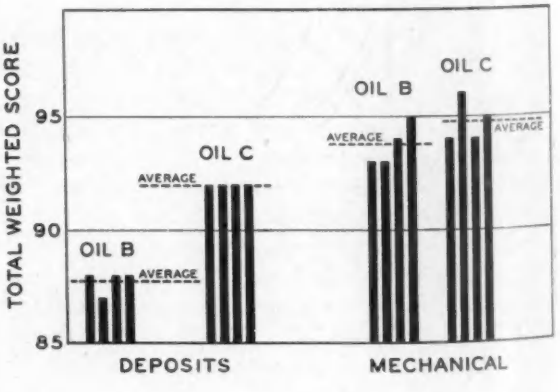
Although Oils A and B are equally good as regards engine mechanical condition, Oil B resulted in marked reduction in engine deposits in lower temperature zones such as crankcases, crankshafts, main bearings, and cams. In higher temperature zones such as the piston-ring belt, Oil B was superior to Oil A, but to a lesser degree than in the lower temperature zone.

TEST SERIES 2

Next step was the testing of Oil C – containing a metallo-organic detergent-dispersant material – with Oil B as reference oil.

No significant mechanical differences between Oil B and Oil C were found in these tests. Ring zone was cleaner with C than with B. Ring sticking, prevalent with Oil B, was practically eliminated with Oil C. Compared with B, C showed greater engine cleanliness in lower temperature zones and less sludge deposits.

But combustion chamber deposits were noticeably worse in oil C, 4 to 10% of these deposits being attributed to the metal in the additive.



Performance in Flying Engines

FROM A PAPER BY **J. T. HENDREN***

mits rating of the oil for both deposits as well as resulting mechanical condition.

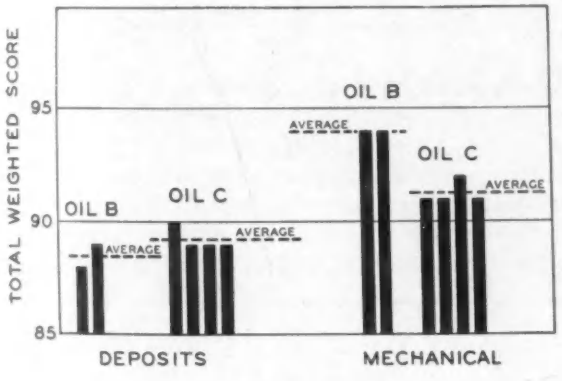
"Score totals," assigned each individual section of the engine on the basis of 100% for perfection, are multiplied by "weighting factors" that stress engine parts more critical in lubrication. Product of the "score total" times the "weighting factor" is the "weighted score" for the individual part; sum of the "weighted scores" is the "total weighted score." This is the final single value obtained by which the oil is rated. Table 1 is an example of a scored engine.

It should be borne in mind that full-scale flight tests of any oil are valid only for the particular engine and operation in which it is tested.

*Paper "Flight Tests of Aviation Oils," by J. T. Hendren, chief chemist, Pan American Airways, Inc., was presented at the SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 8, 1946.

Table 1 – Specimen of Scored Engine Showing Weighting Factors

Part	Mechanical			Deposits		
	Score Total	Weighting Factor	Weighted Score	Score Total	Weighting Factor	Weighted Score
Rings	95	30	28.5	90	20	18.0
Ring Sticking	....	....	....	95	10	9.5
Pistons	95	12	11.4	85	10	8.5
Cylinders	90	10	9.0	90	10	9.0
Valves	85	2	1.7	90	5	4.5
Master Rod Bearings	95	12	11.4	....	....	....
Bushings	95	5	4.7	....	....	....
Rods	....	....	....	90	5	4.5
Crankshaft	....	....	....	85	10	8.5
Pins – Crankshaft	100	10	10.0	....	....	....
Pins – Piston, Knuckle, Damper	95	4	3.8	....	....	....
Main Bearings	100	6	6.0	85	5	4.2
Cams and Tappets	95	2	1.9	90	2	1.8
Crankcase	....	....	....	90	10	9.0
Reduction Gear Assembly	95	5	4.8	90	10	9.0
Miscellaneous	95	2	1.9	95	3	2.8
Total Weighted Score			95.1	Total Weighted Score		89.3
Final Mechanical Score			95	Final Deposits Score		89



TEST SERIES 3

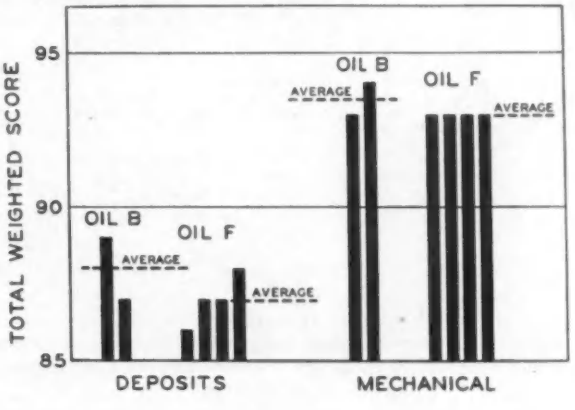
Since Oil C showed promise of improving engine cleanliness, tests were run in three 4-engine planes with Oil C in the two inboard engines and reference Oil B in the two outboard engines.

After flying these airplanes among seven different airports, both foreign and domestic, mechanical condition of piston rings in engines operated on Oil C were slightly worse than those operated on Oil B. Oil-ring deposits were slightly less with C, although it produced slightly heavier piston and combustion chamber deposits. Although Oil C reduced varnish flaking, high hopes held for it were not fulfilled.

TEST SERIES 4

Using the same engine-airplane combination as in Series 3, test Oil F was operated in the inboard engines and reference Oil B in the outboard engines. However, a 100/130 fuel was used instead of the 91/96 fuel for series 3.

Although both oils demonstrated equal mechanical qualities, Oil F showed more flaking in the pin relief area and heavier cylinder deposits above the top rings and on the exhaust valve head and underhead. Rod, crankcase, crankshaft, and cam deposits also were slightly heavier with Oil F than with Oil B. But Oil F did show a slight reduction in oil-control ring side deposits.



Why We Need Sy

AMERICAN motor vehicle manufacturers should continue high-volume use of synthetic rubber to insure long-term price stability and military safety, despite a temporary, small sacrifice in quality and performance involved, says Hale. He points out that:

Manufactured rubber under American commercial control is important to industry from two aspects. First, it will make possible a product with proper quality at low basic price. Second, it will prevent enormous price fluctuations which the rubber industry has had to tolerate in the past.

Nor is dependency upon foreign sources for so critical a military need as rubber in keeping with building an invulnerable military defense. Industry and Government fortunately had sufficient time in the recent war to pool their resources and to develop a war-saving synthetic rubber plant. But there may be no opportunity the next time to stave off attacking forces until our synthetic industry is rebuilt and attains required production.

The Inter-Agency Policy Committee of the Office of War Mobilization and Reconversion, in fact, recommended that at least one third the nation's rubber requirements – about 250,000 long tons per year – should be met by synthetic production. It was further proposed that general-purpose synthetic rubber plants with an annual capacity of 600,000 long tons be maintained in operation or in standby condition. Also emphasized was the need for continued large-scale research by both Government and industry toward improving synthetic rubber quality and reducing its cost.

Although national security demands continued synthetic rubber production, cost and quality stand out as final deciding factors in the survival and widespread civilian application of synthetics.

Through the years, rubber manufacturers have been plagued by terrific variations in crude rubber prices. Fig. 1 illustrates price variations from 1913 to 1946. No industry can be expected to run its business on a sound basis when its principal material undergoes such unpredictable price fluctuations as does natural rubber.

Note that from 1941 on, the price has been constant because it was set and Government-controlled.

Natural rubber price control by the British-Dutch cartel arrangement wipes out any semblance of a free market – a prohibitive drain on both the American public and industry. Rubber prices for several years before the war ran from 18 to 20½¢ per lb despite the excess of productive capacity. Certainly this demonstrates the absence of a free market.

In this article Mr. Hale shows that synthetics already appear to have the price advantage over natural rubber. Side-by-side comparison of man-made and natural rubber tires reveals only minor deficiencies in synthetics.

By way of example of the way Americans are at the mercy of the British and Dutch authorities controlling the price of crude natural rubber, the British increased the price 3¼¢ a pound last summer to the Reconstruction Finance Corp. The RFC protested but to no avail, and since the natural rubber was in such demand, they had to continue

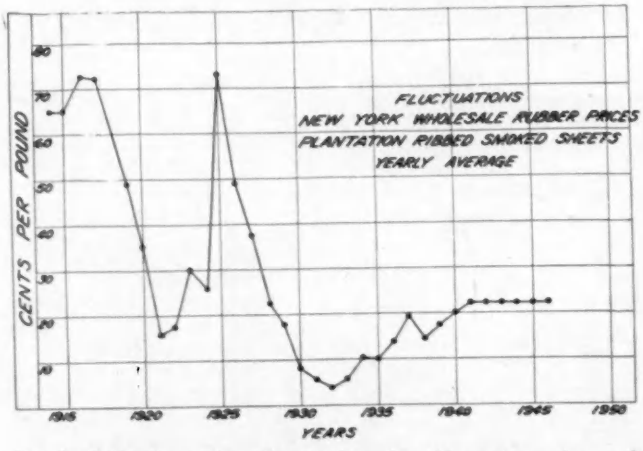


Fig. 1 – Wide fluctuation of natural crude rubber prices, the result of British-Dutch cartel control, has plagued the tire industry. The switch to synthetics would permit a free market and a sounder operating basis

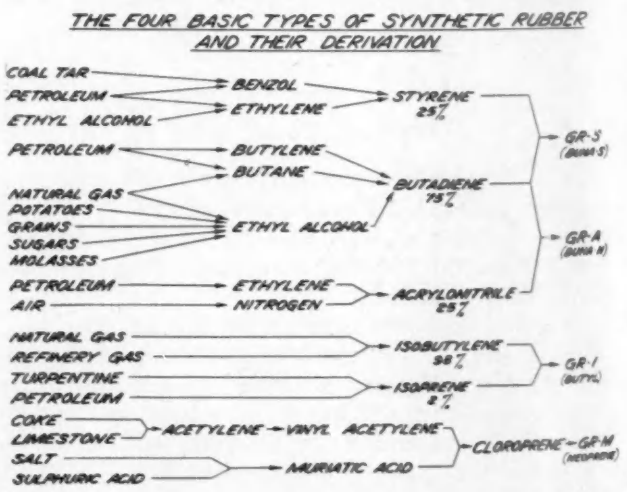


Fig. 2 – Chemical derivation of the four basic types of synthetic rubber

Synthetic Rubber

BASED ON A PAPER BY
J. E. HALE*

buying to the extent of 150,000 tons at this higher price.

Later, stockpiles accumulated in the Far East due to the slowed-up buying, so the British took off the 3¼¢ increase and restored it to its former level. On Jan. 13, 1947, the RFC increased the domestic price to absorb this extra cost so that the American public has to pay more until the 150,000 tons are used up.

Our research chemists can and will make synthetic rubber cheaper than natural rubber, since they start with a raw material that costs only ½¢ per lb – petroleum.

An indication of price-relief using synthetic is given in the Inter-Agency report which states that: "Assuming a reasonable amortization and fair profit, it is anticipated that the price of GR-S to the consumer may be eventually approximately 15 to 16¢ per lb." GR-S presently is being bought by the Government at 18½¢ per lb while natural rubber is sold by the Government to rubber factories at 22½¢ per lb. The Government will shortly reduce the price of GR-I (butyl) from 18½ to 15½¢ per lb. Prospects are good that GR-I will be considerably cheaper, probably the lowest price synthetic when fully developed on a competitive basis.

Continued research and development, he feels, will evolve new polymers – better and cheaper than natural rubber products. To achieve this advantage plus independence from foreign rubber sources, support of synthetic rubber use is urged.

Just as synthetic rubber is being developed to compete pricewise with natural rubber, so will it be perfected to compete in quality. As a matter of fact, performance penalties with synthetics, which are not too serious, will be temporary.

The various types of synthetics developed during the war and the raw materials from which they are made are shown in Fig. 2. Of greatest concern to the automotive industry are GR-S, used in tires, and GR-I (butyl), used in tubes. Percentage of natural and synthetic rubber used in various wartime vehicle tires is shown in Table 1.

Perhaps the most direct comparison of natural and synthetic rubber tires – from the ultimate users' viewpoint – is the trend in passenger car tire life. Fig. 3 shows that synthetics now will give almost the same mileage obtained from prewar natural rubber tires. Carefully supervised road tests show 100% synthetic tires to be worn smooth 10 to 20% sooner than natural rubber tires. About the only other difference noticeable to the public is that S-3 tires are more slippery on ice and snow. This is largely due to the stiffening of GR-S in lower temperature.

As for the characteristics of interest to the engineer, there is little difference between the man-made and natural product. Both are about equal in flexing life or "rubbery" qualities as well as aging or weathering and resistance to solvents and greases. In fact GR-S is superior to natural rubber in radial cracking and curb blistering of sidewalls. But it is somewhat less resistant to tearing, cracks, and cuts in service.

Most important functional characteristic of rubber is hysteresis – efficiency of the stock, or heat buildup. In city or suburban driving this is no problem. But in cross-country driving at high speeds in hot weather, temperature buildup in synthetic tires is 15-20 F higher than in all-rubber tires. At the same time pressure buildup is 1-2 psi greater.

Body strength – particularly resistance to blowouts – is largely a matter of tire-cord tensile strength. Synthetics show practically no deficiency

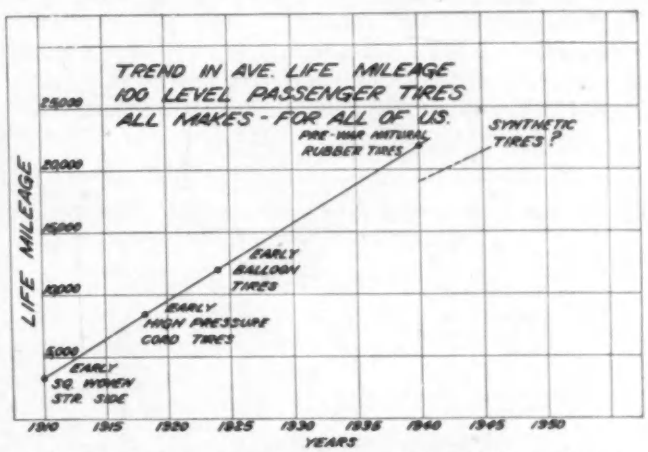


Fig. 3 – This chart conveys the progress made in building quality synthetic tires; their life mileage now compares favorably with that of prewar natural rubber tires

*Paper "Rubber – Will We Make It or Take a Chance?" by J. E. Hale, chief engineer, Tire Division, Firestone Tire & Rubber Co., was presented at the SAE Annual Meeting, Jan. 8, 1947.

Table 1 – Percentage of Synthetic and Natural Rubber in Wartime Tires

Type of Tires	Code	Approximate % Synthetic	Approximate % Natural
Passenger	S-3	100	0
Farm	S-3	100	0
Small Truck	S-3	100	0
Medium and Large Truck	S-6	67	33
Military	S-4	87	13
Earthmover	S-6	67	33
Small Airplane	S-4	87	13
Large Airplane	S-6	67	33
All types of tubes		100	0

of body strength compared with natural rubber tires; however, heat buildup in hot-weather driving does take its toll. Cruising long distances at high speeds builds up enough heat to slightly increase the possibility of weakening the body cord so that it might blow out or separate.

But the slightly greater tendency of tread and ply separation is not entirely a function of heat. GR-S stocks had this tendency to separate because of the difficulty in devising proper adhesives to make the tire an integral unit. For this reason, car and truck owners experienced some tread and ply separation with synthetic tires.

Another item related to efficiency is fuel consumption. Under average driving conditions, the car equipped with S-3 tires will consume about 6% more fuel than with natural rubber tires. (Now that use of 23% natural rubber in passenger car tires is permitted, this figure should be reduced to about 3 to 4%.) Although lower efficiency tires decrease acceleration in hill climbing, the public is unaware of it.

Wartime S-6 truck tires – 67% GR-S and 33% natural rubber – were, at first, a bone of contention between operators and tire manufacturers. It was common practice for truckers to abuse tires by overloading, overspeeding, and to some extent neglecting inflation. The fair number of premature failures leads to constant claims for readjustments.

When the truckers "got religion" and learned how to care for their tires, abandoning old habits, the dissatisfaction ceased. They soon learned what quality was built into the tires and how to operate to get that quality out of the tires.

Performance of S-3 tires on farm equipment was about equal in every respect with natural rubber. Synthetic tire life met with farmers' approval. Since farmers seldom protect tractors and implements from the weather, the fact that GR-S tires stood up as well as they did is a good indication of their aging characteristics.

In tubes, GR-I (butyl) demonstrates a marked superiority over natural rubber. One of its important characteristics is its slow rate of air diffusion, about one-tenth that of corresponding natural rubber stock. Butyl does not tear readily so that there is little likelihood of a butyl tube splitting in the event of a puncture. In case of nail puncture, butyl tube stock often clings to the nail and acts as a puncture-proof tube. GR-I ages well and can be repaired by the same methods used for natural rubber.

Butyl tubes do have their disadvantages; they stiffen up in cold weather. In subzero climates, folds have developed in the tire crown that eventually become creases with holes in them. Another problem is the taking on of a permanent set which sometimes necessitates removal of the tube from the case because it becomes oversize.

From the above, it can be seen that synthetic-versus-natural comparison reveals no outstanding deficiencies in synthetic rubber used in automotive vehicle equipment. Yet development of this new product took place over a very short period of time – a tribute to engineers and chemists. There is no reason to doubt that continued research in universities and industrial laboratories will unearth still better polymers.

The crude rubber situation can go back to its prewar basis unless leading industrialists, engineers, chemists, and military men support continued use and development of synthetics. This is especially true in the light of these statistics:

World productive capacity is 3,400,000 long tons (natural and synthetic) as against an estimated 1947 world consumption of 1,500,000 long tons (natural and synthetic). The world natural rubber productive capacity of over 2,000,000 can more than satisfy this year's estimated demand.

Table 2, the percentage of synthetic and natural rubber agreed upon by industry and Government for 1947 production, indicates the swing back to natural crude.

Our country has $700,000,000 invested in plants to produce synthetic rubber and a lot more public money is being expended toward still further synthetic rubber improvement. To protect this investment as well as the future of this country and to insure rubber price stabilization, the automotive industry should be among the foremost supporters of a program of continuous synthetic rubber development. Only active collaboration of rubber and automotive engineers will bring about new elastomers of superior quality at an attractive price.

Table 2 – Percentage of Synthetic and Natural Rubber Agreed Upon for Postwar Tires

Type of Tires	Code	Approximate % Synthetic	Approximate % Natural
Passenger Car Sizes			
6.00 and smaller	S-8	77	23
6.50	S-9?	77	23
	S-7?	33	67
7.00 and larger	S-7	33	67
Truck Sizes			
Small	S-7	33	67
	S-11	6	94
Medium and Large	S-11	6	94
Farm	S-4	87	13
Earthmover	S-11	6	94
All Airplane	S-11	6	94
Tubes		?	?

How Two-Way Radio Is Adapted to Vehicles

EXCERPTS FROM A PAPER BY **WESLEY C. BAYLIS***

INSTALLING two-way radio telephone equipment in automotive vehicles requires special considerations so that neither the vehicle nor the radio installation interfere with normal operation of each other, but rather enhance each others functions. Two important aspects of this radio-vehicle relationship are space and power requirements of the radio equipment.

Individual equipment items normally comprising a vehicular radio-telephone installation, all of which pose individual space problems, are the radio transmitter, radio receiver, antenna, control unit, handset or microphone and holder, selective signaling unit, loudspeaker, and set of cables.

Radio equipment units are not installed at the same location, but are distributed about the vehicle. The control unit and the handset holder must be located where they will be both visible and accessible to the driver of the vehicle or the person who will use the telephone, while the loudspeaker, if used, must be installed where it can be easily heard. The radio transmitter and radio receiver, together with the selective signaling unit and junction box – if furnished – must be grouped together and may be installed at any location inside the vehicle where they will be reasonably well protected against damage and where they are readily accessible for servicing.

Alternatively, they may be installed outside the vehicle if properly protected from the elements by a weatherproof cabinet. The antenna is an outside-mounting device which may be attached to the top or side of the vehicle, depending on the frequency of the radio channel. The cables connect the various units. Some of the more important factors governing location of these units are discussed in this report.

*Paper "Two-Way Radio-Telephone Suitable for Automotive Fleets," by W. C. Baylis, communication engineer, N. Y. Power and Light Corp., was presented at SAE Annual Meeting, Jan. 6, 1947.

Transmitters and Receivers

At present there is no standardization of unit sizes and the dimensions of transmitters, receivers,

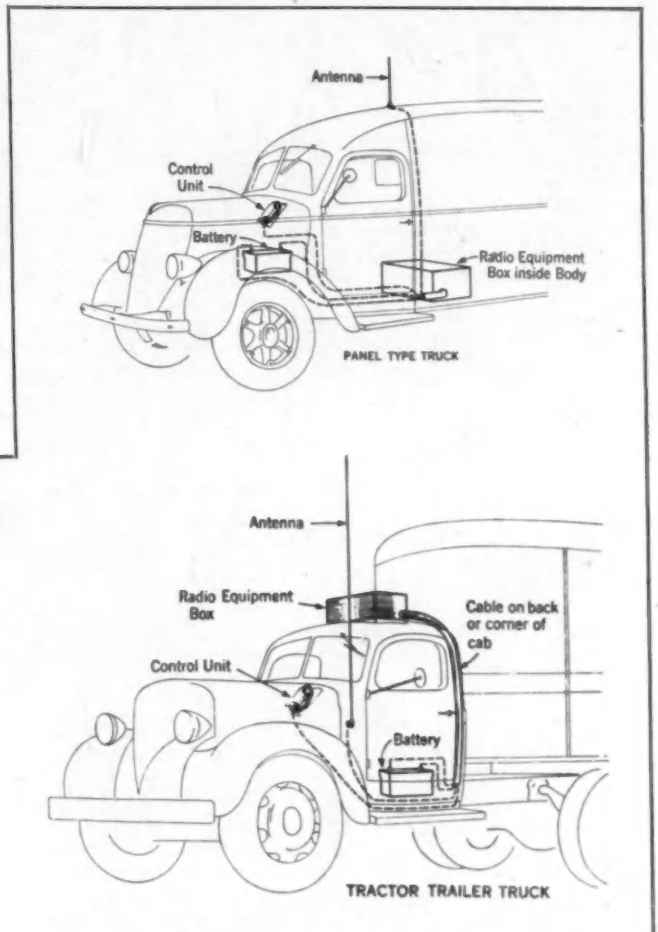


Fig. 1 – These are typical radio-telephone installations in various types of vehicles. Judgment must be exercised in locating radio equipment units for maximum accessibility, convenience, and protection

Two-Way Radio Virtues Extolled

From Discussions by Howard J. Willett, Jr., Willett Trucking Co.; Franklin W. Walker, Central Greyhound Lines, Inc.; A. B. Buchanan, Detroit Edison Co.; Edwin C. Denstaedt, Detroit Police Dept.

TWO-WAY Radio has proved itself to be economically and technically feasible for truck and bus operation, report Willet, Walker, Buchanan, and Denstaedt.

Willett's company installed a radio-telephone system operating on a 152-162 megacycle band in April, 1946 and has used it for dispatching trucks in regular daily operations in metropolitan Chicago.

Although operating data are yet incomplete, radio dispatching has saved the company enough time and mileage in pick-up service to warrant installation of sets in other vehicles in the fleet. Trucks regularly assigned to a full day's work on deliveries are often contacted en route and given a pick-up in nearby localities.

Another convenient use is sending a radio-equipped truck through the freight house at night. Exact location of each trailer is recorded and made available to the morning dispatcher. The tractors go directly to the trailers first thing in the morning and are first at most of the loading docks.

Radio dispatching is mandatory for air-freight pick-ups since the shipper expects speed in handling. Great savings were realized in one application by rendezvousing two or more metros at a convenient location. In this way loads can be transferred to a single truck making frequent airport trips to meet scheduled flights.

Greyhound buses throughout the country are being equipped with two-way radio, according to Walker. Radio contact is highly valuable in tying in various lines so that passengers are not late in making connecting buses.

These operations evolved an interesting solution to the problem of long antennas (on lines operating on a 43-megacyle frequency). An automatic air-operated mechanism lifts and lowers the antenna.

When the driver picks up the hand set, an air relay is automatically operated which lifts the antenna. When he hangs up, the antenna is lowered and lies parallel to the coach. Reception is satisfactory with the antenna down so that the system is practical and eliminates the troubles with long antennas at the same time.

Buchanan, in pointing out advantages his company derived from two-way radio, stressed the absolute necessity for selective calling equipment in public utility operation. Crews are away from the trucks most of the time constructing utility lines. By sounding the truck horn to signal these men, selective calling equipment makes for fullest use of two-way radio.

Another important prerequisite for all public utility vehicles is that they all operate on a single frequency. This will avoid costly modifications in the event a vehicle is shifted from one division to another.

Discussing safety factors, Denstaedt advised that too short a chord on the handset or inconvenient location of the handset is an accident hazard. In such cases, the operator may have to turn his head or lean over in such a way as to obstruct his vision.

The Detroit police operate loud speakers at reduced volume so that a second policeman assists in taking down orders from the dispatcher. This reduces nervous tension of the men in the cars.

and other units built by the various radio equipment suppliers differ markedly.

Results of detailed studies which have been made on the minimum space requirements for the sets of four manufacturers are shown in Table 1. As indicated, the use of selective signaling has been assumed in each case. In arriving at these figures, allowance was made for cables and plugs, and sufficient space was provided to permit withdrawal of plugs or removal of dust covers from the units.

It is advisable to mount the radio units in an equipment cabinet which will keep out dust and protect them from damage. Some suggested locations for these cabinets on various types of vehicles are illustrated in Fig. 1.

Space limitations in tractor-trailer units are very severe. The only space available in some tractors is on top of the cab, as shown on Fig. 1. It is recognized that a minor design change might be made in tractor cabs which would permit accommodating the radio apparatus inside. Some radio equipment has been arranged in a long "package," and space behind and under the driver's seat is adequate.

Control Units

Control units and handsets must be installed where they will be conveniently accessible and clearly visible to the operator. It is customary to locate a control unit beneath the instrument panel, in the center of the vehicle, in such a manner that the front surface of the unit is flush with the panel. When the unit is installed at this point, the driver can see the pilot lights and reach the switch with his right hand, and the radio equipment may also be operated by the other occupants of the front seat.

Final choice for the location of the control unit will be dictated by numerous considerations, among them the personal preference of the operator and the possibility of mechanical interference between the control unit and the cowl ventilator, car heater or other accessories.

Handset or Microphone and Holder

Criteria for accessibility and visibility of control units apply with equal validity to telephone handsets (or military-type microphones). A handset

Table 1 – Minimum Space Requirements for Mobile Radio-Telephone Equipment*

Equipment Manufacturer	Frequency in Megacycles	Dimensions in Inches		
		Length	Width	Height
A	152-162	21	21	10
A**	152-162	21	11	19
B	152-162	28	22	15
B	30-40	27	18	13
C	30-40	28½	18	13
C	152-162	28½	18	13
D	30-40	25	18	13

* Including telephone-type selective signaling equipment.
** Alternative layout.

should be mounted where the driver can reach it easily with his right hand, and where it is also within reach of front-seat passengers. Three types of handset mountings are in general use at present.

The hanger type, which is installed on the instrument panel, consists of a hook or retainer which holds a military-type microphone or the receiver end of a telephone handset, and allows the instrument to hang down in a vertical position. The cradle-type handset holder, shown in Fig 2, mounts on the horizontal surface above the instrument panel, between the top of the panel and the windshield. The combination control unit and handset holder has a receptacle into which the handset drops back out of the way, yet remains within easy reach.

Loudspeakers

Loudspeakers are not used where the mobile radio unit connects with the general telephone network, and may or may not be used with privately operated communication systems. Speaker units may be mounted in a number of locations, and the following table lists some of the more common ones:

(a) On the fire-wall;
(b) Behind the instrument panel, pointing down;
(c) Behind a grill on the instrument panel, pointing out at the driver;
(d) Over the windshield, concealed behind the upholstery;
(e) Over the windshield, exposed to view;
(f) At ear level, close to driver.

Loudspeakers used for mobile radio applications are generally either 5 or 6 in. in diameter (uncased) and their thickness will not exceed 4 in., so that a space 8 in x 8 in. x 5 in. will be more than ample for the installation of any speaker unit.

Antennae

Three frequency bands, 30-44 mc, 72-76 mc, and 152-162 mc are at present assigned to mobile service, and each band requires a different antenna. And although the same radio transmission considerations apply to the location, the antennae for the bands are generally mounted differently.

The reason for this apparent inconsistency is that the antenna for 30-44 mc is approximately 7 ft long, for the 72-76 mc it is 3 ft, and for the 152-162 mc only about 18 or 20 in. long. The two shorter antennae should be installed at the center of the turret top on a passenger car or panel-body truck, as illustrated in Fig. 1, or at the center of the cab top on a cab-type truck to obtain optimum radio transmission.

If the radio equipment is placed in a cabinet on top of the cab, the short antenna may be mounted on top of the cabinet. If the truck proper or the trailer is several feet higher than the cab top, some means must be devised for getting the antenna up in the clear where it will not be shielded by the body.

The antenna for 30-44 mc, on account of its greater length, might be an accident hazard if installed in the same manner as the short antenna, since it could more readily come in contact with overhead wires. Also, it would be more subject to damage by tree and such overhead structures as garage doors and underpasses. Furthermore, some states have clearance laws which might be interpreted as prohibiting the installation of a 7-foot antenna on top of a vehicle.

Cables

Serious consideration should be given to the problems involved in running cables between the various components of the radio installation. At present no provisions are made in vehicles for radio cables and consequently the installation of these cables accounts for a major portion of the total radio installation cost. It is hoped that vehicle manufacturers can be encouraged to put holes or knockouts in convenient locations and design frames and bodies with space for cables.

In a passenger car, for example, the battery and control cables from the radio set in the trunk are customarily run forward underneath the car. It would be highly desirable if provision for easy installation were made. It would also be helpful if small holes were drilled or punched for cable clamps to hold the cables in place.

It is felt, however, that any holes in the frame should be made at the factory in accordance with structural design plans, since a mechanic in the field might weaken it by inadvertently drilling holes at certain critical points. Ultimately, it is hoped that manufacturers will provide raceways or

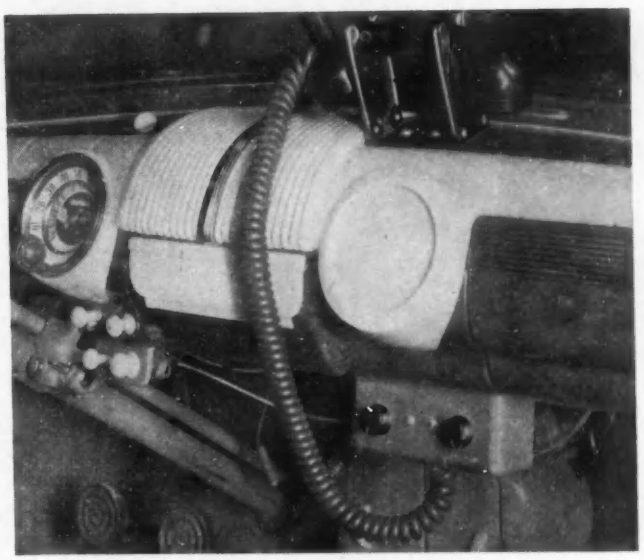


Fig. 2 – The space above the instrument panel – at about the center – is most convenient for installing cradle-type handset holders since most windshields are V-shaped

conduits for the radio cables. Whether exposed or enclosed, the cables must not run close to the exhaust pipe, as heat deteriorates the insulation.

A survey of two-way mobile radio equipment now being manufactured reveals that, for FM sets in the 30–40 megacycle band, stand-by current drain varies from 6.2 amp to 12.75 amp. Current required for transmitting varies from 36 amp to 76.2 amp. For sets operating at a frequency of 152-162 megacycles the stand-by current drain varies from 6.3 amp to 17.8 amp. Transmitting current drain varies from 41.0 amp to 81.8 amp.

These wide variations in current demand by sets of different manufacturers make it necessary to consider average conditions when estimating power supply requirements for two-way radio operation.

The generator should be of such capacity and so designed that it will be capable of supplying the total current requirements, except transmitting load, for all electrical equipment on the vehicle. The generator should have sufficient capacity to replenish the energy taken from the battery in addition to supplying all of the electrical requirements when the vehicle is in operation.

The battery should have the capacity to supply electrical energy to the electrical system for starting purposes and for the operation of electrical equipment such as lights and radio for limited periods when the generator is not operating.

If a particular category of service imposes an accessory load or operating conditions that prevent the generator or battery from functioning in the manner outlined above, then the electrical system of the car is no longer self-sustaining. Necessity for frequent battery recharging and reduced battery life expectancy will be among the disadvantages of this type of operation.

Generator requirements for light trucks and cars will vary due to the vehicle usage, but operating experience indicates it is desirable to have a generator with a capacity 20% greater than the total operating load, and generator characteristics and engine drive ratio such that the generator is capable of delivering maximum output at the normal operating speed of the vehicle.

If the average running speed of the vehicle is to be less than 25 mph a generator should be selected which charges at an engine idling speed of approximately 500 rpm. If the average running speed of the vehicle is to be 25 mph or more, a

Method of Determining Approximate

THESE three points of information must be assembled to determine battery and generator requirements:

1. Estimate of vehicle operating load (including radio communication receiving load) under intended operating conditions;

2. Maximum number of hours the battery will be required to supply radio communication stand-by service with generator idle;

3. Number of hours available for charging with the vehicle generator.

Operating load can be determined by the tabulation similar to the one shown in Table 2 for a light delivery truck.

Table 2 – Tabulation of the Operating Load for a Light Delivery Truck

Unit	Amperes Required			
	Summer		Winter	
	Day	Night	Day	Night
Head Lights	....	14.0	....	14.0
Tail Lights	....	1.2	....	1.2
Instrument Lights	....	0.8	....	0.8
License Lights	....	0.6	....	0.6
Fog Lights	....	....	....	....
Spot Lights	....	....	....	....
Clearance Lights	....	....	....	....
Ignition	1.7	1.7	1.7	1.7
Gauges	1.0	1.0	1.0	1.0
Heater and Defroster	....	....	7.0	7.0
Entertainment Radio	....	....	....	....
Electric Windshield Wiper	....	....	....	....
Communication Radio	10.0	10.0	10.0	10.0
Total	12.7	29.3	19.7	36.3

Suppose that in this illustrative case, 2 hr is estimated as maximum time the battery will be required to supply radio-communication stand-by service and 3 hr is estimated as the time the generator will be charging the battery.

Chart 1 will show the additional generator capacity required to replace the estimated drain of radio-communication stand-by service on the battery.

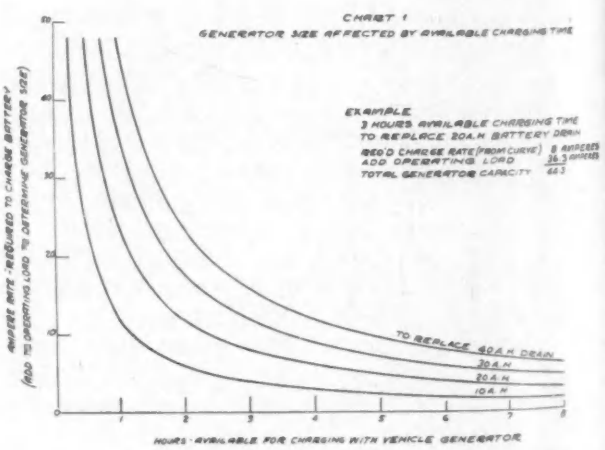


CHART 1
GENERATOR SIZE AFFECTED BY AVAILABLE CHARGING TIME
EXAMPLE
3 HOURS AVAILABLE CHARGING TIME
TO REPLACE 20 A.H. BATTERY DRAIN
REQ'D CHARGE RATE (FROM CURVE) 6 AMPERES
ADD OPERATING LOAD 36.3 AMPERES
TOTAL GENERATOR CAPACITY 44.3
TO REPLACE 40 A.H. DRAIN
20 A.H.
10 A.H.
HOURS AVAILABLE FOR CHARGING WITH VEHICLE GENERATOR

Assuming a 10-amp battery drain for 2 hr results in a 20 amp-hr drain. Entering Chart 1 on the 3-hr generator charging period for a 20 amp-hr drain shows that the generator must have sufficient ca-

generator with normal cut-in characteristics may be used. Most vehicles have standard equipment generators which are capable of delivering maximum output at a vehicle speed of 25 mph.

With the generator charging (supplying all current requirements) at least 75% of the time the radio is used, standard equipment generators of 30-35 amp capacity may in most cases be used. Under these conditions night usage must be only a small percentage of the total operating time.

If the generator is charging from 50 to 75% of the time the radio receiver is used, the condition may be considered a border line case and the requirement for a larger capacity generator will depend upon the total connected load and operating conditions such as amount of night driving anticipated. In general, as the ratio of generator charging time to radio operating time is decreased, the need for higher generator capacity increases.

Selection of the proper size battery depends on two factors: (1) length of time battery will be required to furnish stand-by power for radio operations, (2) battery should be of sufficient size to withstand service conditions without decreasing life of battery.

If the battery is not to provide current for stand-by service, then the original equipment battery will be adequate.

To provide for emergency stand-by receiving capacity over approximately a 4-hr period, a minimum battery capacity of 150 amp-hr at 20 hr rate is recommended for cars or light trucks which are originally equipped with batteries of 120 amp-hr capacity or less. If the original equipment battery is larger than 120-amp-hr then an increased capacity of 25% over the original equipment size is recommended. Batteries of this increased capacity may be expected to give normal service life under these conditions. The operation of transmitters by battery power is not recommended.

A more factual estimate of generator and battery requirements may be obtained through a survey of the vehicle electrical load and an evaluation of the generator's and battery's ability to supply anticipated power requirements. (Procedure in making this determination is shown below.) If the check shows the original equipment to be marginal or inadequate, the vehicle manufacturer should be asked for specific recommendations.

Generator and Battery Requirements

pacity to furnish an 8-amp minimum charge rate. Adding to this the winter night-time operating load of 36 amps reveals that the generator must have a minimum capacity of 44 amps.

CHART 2
SHOWING THE MAXIMUM CHARGE RATE A 3/4 CHARGED BATTERY WILL ACCEPT AT VARIOUS BATTERY ELECTROLYTE TEMPERATURES (LIMITING FACTOR IS BATTERY COUNTER ELECTROMOTIVE FORCE)

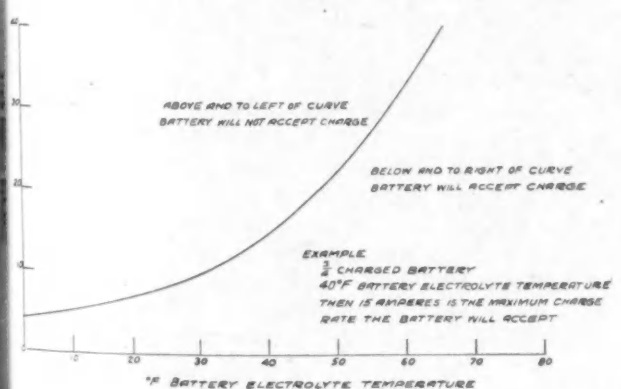
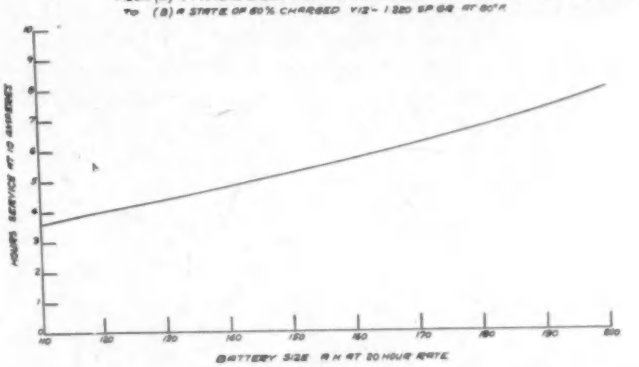


Chart 1 assumes the battery will accept an unlimited rate of charge. But ability of the battery to accept charge is limited by factors such as battery temperature, state of charge, and battery construction. Chart 2 showing maximum charge rate a partially discharged battery will accept at various temperatures, should be used in checking the ampere-charge rate determined from Chart 1.

Checking with Chart 2 for this example shows that the battery will accept an 8-amp charge at all battery temperatures above 25F.

Chart 3 shows the hours of radio-communication stand-by service that normally can be expected from batteries of various sizes.

CHART 3
HOURS SERVICE AT 10 AMPERES AS A FUNCTION OF BATTERY SIZE
BATTERY TO DISCHARGE
FROM (a) A TYPICAL OPERATING STATE OF CHARGE 1/2 - 1.270 SP GR AT 80°F 1/2 - 1.225 SP GR AT 80°F
TO (b) A STATE OF 80% CHARGED 1/2 - 1.320 SP GR AT 80°F



Using the assumed 10-amp load for radio-communication stand-by, Chart 3 shows that a 120-amp-hr battery in the truck would have ample capacity for expected stand-by requirements. However, this does not take into account service life expectancy. For normal battery service life, a battery of 150 amp-hr capacity (20-hr rate) is recommended for mobile equipment with two-way radio communication.

Plastic-Paper Enhances

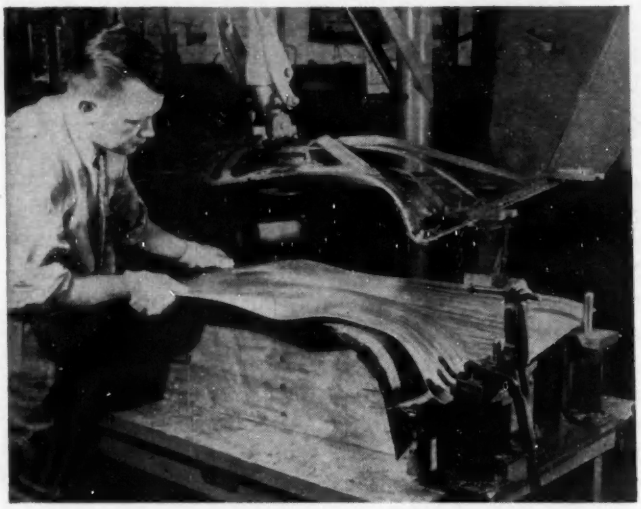


Fig. 1 – Plastic laminate panelling, formed on wood dies, is said to be sturdier and cheaper than conventional materials used for car interiors

KEEPING application of plastics in step with plastic development is the only sure way for automotive designers to use the material to best advantage. Violating this principle has been expensive to both the plastic and automotive industries in the past. But low-pressure laminates are an example of how abiding by the rule pays dividends to all.

These laminates, developed by Briggs Mfg. Co., are now replacing traditional wooden construction in the interior of cars such as the 1947 De Soto Suburban. They consist of high-strength paper, on which has been reproduced decorative grain effects, laminated to a core of heavy phenolic-resin impregnated alpha cellulose paper. The sandwich is finished on the back with a second skin of undecorated high-strength paper.

In the Suburban, four laminated door panels, two rear quarter panels, one rear deck, and two strips mounted between the door comprise the entire inside surfacing. Three tones are used in the door panelling.

Withstands Wear and Tear

Months of weathering, fading, abrasive, and downright abusive tests proved this plastic can take it. Mounted side by side in test cars with conventional materials, the laminates came through with little, if any, signs of wear or scratching; the standard materials were scuffed, worn, and generally unusable. That the material is being used first in a station wagon model is evidence that it will stand up under most adverse conditions.

Less spectacular, but equally significant is the second use being made of this decorative sandwich structure – a garnish molding for the rear of the front seat.

This laminate development elevates plastics to a role of major importance in the automotive field, placing it on a par with traditional materials such as wood and steel. Not only will decorative laminates make for a better car, one that both wears and looks better, but it should also make for a less costly car. Laminates are cheaper than conventional panelling materials.

Important factor in keeping cost down is speedy production – developed to where it will more than keep a standard assembly line in operation.

Each of the two laminate types – interior panelling and garnish molding – are produced by distinctly different methods. For De Soto parts, a hot forming method is employed; for garnishing, a process similar to that used for molded laminates is followed. But both processes use the same type of sandwich.

Varied Colors and Patterns

First step in the hot forming method of processing is the layup of the impregnated paper sandwich. This sandwich, composed of heavy alpha cellulose paper as a core, is covered with a skin of impregnated high-strength paper – plain-colored for the back surface, which will not be exposed, but printed by standard rotogravure methods for the surface that shows. Any design in any combination of colors can be achieved in the outer decorative sheet since a transparent phenolic resin is used on the exposed surface side of the sandwich.

In the 1947 De Soto Suburban, the effect is that of wood grain; authenticity of the graining is assured since actual wood grain was the copy for the printing plates. Variation is achieved by the use of two colors and two grains of paper in the door panelling, as compared to the single sheet of grained paper in the rear quarter panels, rear deck, and between door strips.

With the core laid up, the phenolic-resin impregnated high strength printed paper is cut to shape

Sandwich Car Interior

FROM A PAPER BY

Fred B. Stanley*

and placed in position on the sandwich. This requires care when sheets with different graining are used in the same assembly. The entire sandwich is then placed in a laminating press and cured at a temperature of about 350 F for 1½ min. The cured laminate is taken from the press and held flat by a wooden form until it is cooled. This procedure during cooling is necessary because the laminate is unbalanced and would warp if it were not held flat.

Curing and cooling completed, the panels are reheated by a bank of infra-red lamps to approximately 300 F. The time cycle on this infra-red heating is accurately controlled by an automatic time switch. As this switch cuts off the infra-red lamps, the preheated sheet is moved to position in the stamping die and another sheet is placed in the preheater. Die cutting of these laminates is very similar to a stamping operation and the speed of the operation is the same.

Warped Shapes Possible

Production of the panels for the rear deck and the rear quarter section is not so simple since these parts must be formed to shape. The die cutting of the material is the same, however, as for the flat panels. When they are to be formed, the hot sheets are taken directly from the die cutting operation and, while still hot, are placed in a simple forming die.

The die-cut heated laminate is placed on a wooden male form which makes up the lower half of this die. The upper portion of the die is merely a skeleton frame which presses on the laminate at certain strategic points to make it accurately take the required form. Fig. 1 shows this forming jig in the open position with the operator removing a formed panel which, after a few further operations such as the drilling of assembly holes, will become the rear quarter in a Suburban.

Forming dies used to shape these laminates are generally produced from wood at a very low cost. For one particular formed part the actual money outlay for the mold was estimated at $250. This figure included the cost of the material and time consumed in the production of the die.

Savings in Tooling

The savings are most evident when comparison is made between the cost of these forming dies and the cost of metal dies for the same parts. Take as an example a job currently under test which comprises two left hand and two right hand panels calling for four different molds. Using the hot forming process the forms cost about $1,000. If the dies had been made of steel, it is estimated that each die would have cost in the neighborhood of $20,000, making a total die outlay of $80,000 for the four.

Steel molds are, however, required in the second method of processing these laminates – the method which is similar to that used in the familiar molded laminate, and which the Briggs Mfg. Co., employs for such parts as the garnish molding. But these steel molds are still not as expensive as metal stamping dies. Parts coming from the mold require only nominal finishing, their surface appearance and texture being molded in.

The same type of sandwich is used as for the interior panelling of the Suburban, but it is used differently. Each mold charge of phenolic-resin impregnated paper is first die cut to size, then loaded in the mold, and molded in a manner very similar to that used for what the plastics industry knows as molded laminates. There is one difference, and a very important difference. The cure is completed in 90 sec.

It takes little imagination to visualize many other applications for this type of material. Because of the unlimited color range and design possibilities, there is little question but what this development will become of great importance, not only to the automotive industry, but to any industry which requires strength, durability, and beauty in the materials it uses.

Moral of this story is that when the designer knows the properties and the limitations of the material he is working with, he can achieve a product of maximum utility and looks at minimum cost. This has been true for metals and wood; it still holds for plastics.

* Paper "Some Things Old and Some Things New in Plastics," by F. B. Stanley, engineering editor, Modern Plastics, was presented at SAE Annual Meeting, on Jan. 7, 1947.

1947 Aero

1947 WILL probably see the introduction of more new types of aircraft than any previous year in the history of U. S. air transportation. Scheduled for service are the new Lockheed Constellation Model 649, designed for commercial use and not a military adaptation as was the Model 49; the new Douglas DC-6; the Boeing Stratocruiser; the Martin Models 202 and 303; the Convair 240; and at least two other smaller aircraft.

The Douglas, Martin, and Convair models will be powered by the Pratt & Whitney R-2800 series engines which have yet to see transport service, although an impressive military record has been accumulated. The Boeing Stratocruiser will be powered by the largest air-cooled engine ever built for commercial use, the new Pratt & Whitney R-4360, and in addition will incorporate the first commercial turbo-supercharger installation. The Lockheed Constellation Model 649 will be powered by a brand new version of the Wright R-3350, which has been developed specifically for commercial installations from experience gained during the war on military models.

These and other new engine models will derive higher specific outputs and lower fuel consumption by the utilization of war-born devices, such as, fuel injection, water injection, exhaust turbo installations, jet exhaust stacks, and improved cylinder and valve cooling.

Fuel Injection: Airline operators recognized the advantages of cylinder head fuel injection back in 1937 when TWA conducted 300 hours of flight operations at high altitudes and under a variety of weather conditions in a Wright powered Northrup Gamma airplane, equipped with cylinder head fuel injection. It was not until nine years later, however, that the first commercial airline fuel injection installation took place.

Engine manufacturers did not push fuel injection development enthusiastically, in spite of airline operators' insistence, because of the complication of the equipment and the resultant high cost of development, the higher installed weight as compared to the conventional carburetor, and the feared high maintenance costs. The severe backfiring characteristics of the R-3350 with resultant induction system fires, forced the early installation of fuel injection in the military B-29 and the commercial Constellation.

Airline operators have been amazed at the lack of maintenance trouble encountered with fuel injection equipment. Few flight delays have been encountered, and premature removals have been almost entirely due to small leaks found during ground inspection. These leaks are primarily the result of improper installation due to mechanics, lack of appreciation of the care required in the protection of gaskets and finely polished mating surfaces. Improved gasket designs being incorporated are expected to largely eliminate premature removals of fuel injection equipment.

The real advantages of fuel injection have been realized in greater fuel economy, reduced engine vibration, freedom from induction system icing, reduction in spark plug fouling, and improved cooling. These factors add up to greater airline safety and reduced operating costs.

Constellation flight experience to date indicates that carburetor pre-heat is no longer necessary. Indeed, the manufacturer recently proposed to largely eliminate the pre-heat muff so that undercowl air could be used continuously during impact icing conditions. Impact-ice-free airscoops can be designed today and the author confidently predicts that within the next year or two, fuel injection equipped airline aircraft will be flying without either carburetor pre-heater controls or carburetor alcohol.

The Constellation Model 49 was equipped with fuel injection at a cost of 340 pounds per aircraft. Pre-heat and carburetor alcohol installations will not be removed until a full winter's operating experience has been accumulated, but when these installations are removed, the total weight increase will be reduced by an estimated 100 lb. Against this weight increase is a proved fuel consumption decrease of 150 lb/hr/plane with short range cruising power, and 60 lb/hr/plane with long range cruising power. This results in a net payload increase of 360 lb on a 2000 mile flight, assuming pre-heat controls removed, and no payload loss on short range flights.

Real money savings accrue from reduced fuel consumption. Assuming 100 octane fuel cost at 14¢ per gal, 10 hr per day utilization with a fleet of 20 4-engine airplanes and an average cruising power resulting in 100 lb per hr fuel reduction, the airline will save $170,000 a year on fuel as a direct result of fuel injection.

Similar improvements can be expected on practically all internal combustion engines, therefore, it is a distinct possibility that today's nozzle bar carburetor will be as obsolete in a few years as the float type carburetor is today.

Powerplants

EXCERPTS FROM PAPER BY

R. C. LOOMIS*

Water Injection: Effect of water injected into the induction system upon the octane requirement of gasoline engines has been known for years, but the first successful application of this principle to aircraft engines occurred during the war. Highly boosted military engines, especially those equipped with turbo-superchargers, required expensive and critical special fuels if they were to obtain the last ounce of power during combat and heavily loaded takeoffs, but when water or water-alcohol mixtures were injected into the induction system during these short, peak power periods, regular 100 octane fuel could be used and engine life appeared to improve.

Presently available engines are not highly boosted, therefore, takeoff power full throttle is reached at 2000 to 5000 ft on the same fuel grade as required for cruising. This means that only at sea level can appreciable power gains be made through the use of water injection. Since the takeoff distance is less critical at sea level than at the higher altitudes, the approximately 100 lb per engine required for water injection cannot generally be justified.

At least one operator is considering the use of water injection for all takeoffs in order to reduce engine wear and spark plug fouling.

Exhaust-turbo-superchargers: High altitude operation is required for maximum passenger comfort and speed, particularly, on long range flights. Some form of exhaust utilization must, therefore, be provided if the required engine supercharging is to be obtained without loss of operating economy. Exhaust-turbo-superchargers are generally preferred to multi-stage engine driven supercharging with jet stacks because the flexibility of operation is less than that of the exhaust turbo and the noise problem associated with jet stacks poses a considerable problem in commercial operation.

The small, or cruising turbine used on the Boeing Stratocruiser will allow use of maximum cruising power up to 25,000 ft at an expense of approximately 250 lb per engine. Since sea level fuel consumption is maintained up to this altitude, the additional weight appears small compared to the advantages gained, that is, over-weather operation and a 50% increase in speed at 25,000 ft compared to sea level.

"Will maintenance costs and mechanical delays be materially increased?" W. E. Beall, vice-president of Boeing Aircraft, answered this question.

"The addition of a turbo supercharger to an aircraft powerplant of necessity increases the complexity of the powerplant installation through the addition of the turbo itself, intercooler, more extensive exhaust and air intake systems, controls, and so forth.

"Fortunately, it has been proven through many hours of operation that service and maintenance on those portions of the powerplant system are no particular problem.

"The air ducts and intercoolers have proven to be almost entirely maintenance-free and even in military use the overhaul periods on the turbos themselves exceed 1000 hr. In general, the use of a turbo-supercharger is a light weight, low drag method of maintaining power to high altitude without a sacrifice of fuel economy.

"It gives an altitude flexibility in operations which will undoubtedly contribute largely to schedule regularity through pilot's ability to pick his weather on an altitude basis and through increased pilot confidence."

Exhaust-turbos allow cabin supercharging by means of turbo bleed rather than requiring complicated and heavy mechanically driven cabin superchargers which are subject to frequent failure. Exhaust-turbo installations will become a "must" on all new long range aircraft designs.

Cylinder and valve cooling: Aircooled engine manufacturers are constantly working on new designs and processes which will improve cylinder cooling. The year 1947 will see the commercial introduction of at least two engine types of high specific power output achieved through improved cylinder design and arrangement for optimum cooling.

The Pratt & Whitney R-4360 engine introduces the "corncob" cylinder arrangement in conjunction with an entirely new concept of valve arrangement so that baffle pressure drop is low and cylinder finning is very clean. The R-4360 cylinder design is such that even temperature distribution should be achieved, therefore, valve and piston difficulties should be minimized.

The Wright R-3350 C18BD engine achieves low baffle pressure drop and good temperature distribution in the cylinder as a result of at least 11 special design features. These design changes increased fin surface to optimum by a large reduction in both

* Paper "Transport Aircraft Powerplant Outlook for 1947" presented by R. C. Loomis, director of engineering & overhaul, Trans World Airlines, at the SAE Annual Meeting, Jan. 10, 1947.

thickness and spacing. The height of the fins was gradually increased from relatively low valves over the front portion to the highest feasible valves in the rear in order that the air passing over the cooler front portion would not be heated up until it could be utilized over the hotter rear region.

Substantial improvements to baffling were made, facilitated by elimination of steps in the outside fin contours, and by designing for continuity of the head and barrel fin tip contour line.

Future developments: This year will not see the introduction of any gas turbine-powered aircraft to commercial service, at least in the United States.

But the turbine-propeller engine is being extensively developed here and abroad because this type can most easily be adapted to existing aircraft designs and because, in theory, this type promises the greatest gains in increased performance and payload, particularly on long range flights. The author has concluded that turbine-propelled powerplants are still several years from being practical for airline use.

In contrast, turbo-jet powerplants are today being extensively used in military aircraft, and they have reached such a state of development that they could be successfully used in commercial operations today if the proper aircraft were available. Since new aircraft models must be developed, in order to efficiently use turbo-jets, however, it appears that the introduction of turbo-jet powered commercial transports into scheduled service is at least three years away.

Unfortunately, aircraft designers appear to associate the use of turbo-jets only with aircraft flying in the supersonic range, with the result that conventional aircraft designed for flight in the 450 to 500 mph range are being neglected. The airline operators are not immediately interested in supersonic speeds because of the attendant operational problems, but the early introduction of a medium range, 450 mph, turbo-jet powered transport is both desired and feasible.

A turbo-jet powered transport would offer not only a substantial increase in cruising speed, but almost vibrationless and noiseless flight, all extremely desired from a passenger sales standpoint.

In addition, the simplicity of structure and control system associated with turbo-jet engines offer attractive possibilities for maintenance cost reduction.

AAF PLANS

cont. from p. 22

program planning if we had a guarantee of a minimum yearly amount.

As a result of the lessons of the war and a realization of the highly scientific nature of our future weapons, we must maintain the closest sort of coordination with the scientific talent of the country. This has been recognized by the establishment of the Joint Research and Development Board by the Secretaries of War and Navy and the appointment of a scientist, Dr. Vannemar Bush, as head of that Board. It has been further recognized by creation of a Scientific Advisory Board, consisting of approximately 30 of the country's leading scientists in the fields pertaining to aeronautics, to advise the Commanding General of the AAF on his research and development program. Within the Engineering Division we have given impetus to the tie between the military and science by placing many so-called "study" or "research contracts" with various universities, research laboratories, and similar nonprofit institutions for possible application of their research findings to specific items of military equipment.

Our relations with industry are even more important since it is to industry we must turn for assistance in development and for production of the articles which basic research of the scientists indicate we must have. Our victory in the past war was unquestionably due primarily to this nation's industrial might. We sincerely hope there will be no future emergencies but development of superior weapons and an industry geared to produce them immediately are our best insurance for a lasting peace.

AIRLINE ECONOMICS

cont. from p. 35

mula. In a typical case of a 100-plane fleet, the formula shows that 50 lb added payload per airplane can represent a revenue of $184,000 annually.

Obviously efficient airline operation depends on careful engineering control of weight to insure maximum payload. Fig. 1 demonstrates the trend toward higher daily ton-mile capacity in airplanes which must be accelerated by such realistic application of airline economics.

Increasing overall revenue is shown to demand study of many items other than weight. High aircraft utilization, both direct – such as increased daily hours of operation – and indirect – such as maintenance man-hours in keeping with fleet size and airplane use – can trim excessive operating costs.

Cruise control, overhaul time, and seating capacity are other areas that bear close scrutinization for possible cost-consuming parasites. Cost-conscious responsibility cannot be shirked by technical personnel in the face of the airline industry's phenomenal growth and financial investment.

ELECTRONIC EYE Bares Engine Flying Woes

FROM A PAPER **By John E. Lindberg, Jr. and Clifford Sackett***

This paper will be published in full in SAE Quarterly Transactions

PICTORIAL detection of aircraft engine troubles in flight with a recently developed engine analyzer can eliminate flight delays due to ground trouble-shooting and increase flying safety by warning of impending failures.

This instrument gives continuous visual analysis of the complete powerplant. On its scope are shown characteristic patterns of ignition-system performance, changes in mixture distribution, synchronization between magnetos and engines, engine roughness, and vibration. By properly interpreting these patterns, the flight engineer can locate and identify existing troubles, anticipate others, and adjust the engines for optimum operation.

His flight diagnosis is relayed to the maintenance crew chief on landing and the remedy can be effected without further ado. No time need be lost for costly ground trouble-shooting and checking. Sometimes flight troubles do not show up in ground run-ups, further delaying the schedule.

The analyzer can save many thousands of dollars annually by rendering such service. Loss of a single day's flight utilization of a Boeing Stratocruiser represents a $26,000 income loss. Compare this with the total cost of $18,000 for carrying the 90-lb analyzer in a transocean service plane for one year. Realizing how many days a year an airplane is grounded because of inadequate means of immediately detecting engine trouble, one can see how this equipment can pay for itself many times over in short order.

The analyzer itself, shown schematically for a 4-engine airplane in Fig. 1, is divided into a number of components because of functional and space requirements. Its units are the cathode ray tube indicator, condition-selector switch, cylinder-selector switch, and the power-supply sweep-amplifier.

An engine-driven switch is mounted on each engine's spare tachometer drive and driven at half engine speed (one complete engine-switch cycle per engine cycle). The switch is connected through the fire-wall junction box to the cycle selector portion of the cylinder-cycle selector switch.

The cycle-selector switch determines what part of the engine cycle timing diagram appears on the graphical indicator screen (cathode ray tube). With it, any one of the equally spaced engine switch contacts can be activated by touching its switch arm, a synchronizing pulse just ahead of ignition on the selected cylinder. The pulse trips a circuit in the power-supply amplifier, causing the electron beam to sweep across the face of the cathode ray tube.

On an 18-cyl engine, the circuit is designed to sweep across the tube in one-ninth of a complete cycle at cruising engine speed. Pushing a button on the cylinder-cycle selector switch will slow the beam down so it traverses the screen in one engine cycle.

The condition-selector switch also is wired to the magneto primary ground wires to give a true pic-

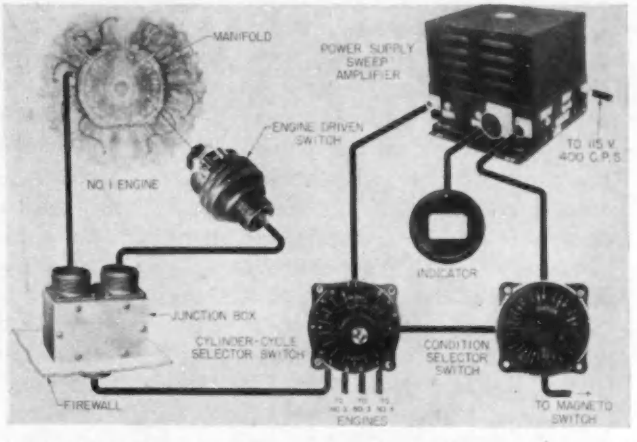


Fig. 1 – This is how the engine analyzer for trouble-shooting in flight is hooked up to the engine

*Paper "Engine Trouble Shooting in the Air," by J. E. Lindberg, Jr., staff engineer, Pan American World Airways, and Clifford Sackett, chief engineer, Lindberg Instrument Co., was presented at the SAE Annual Meeting, Jan. 9, 1947.

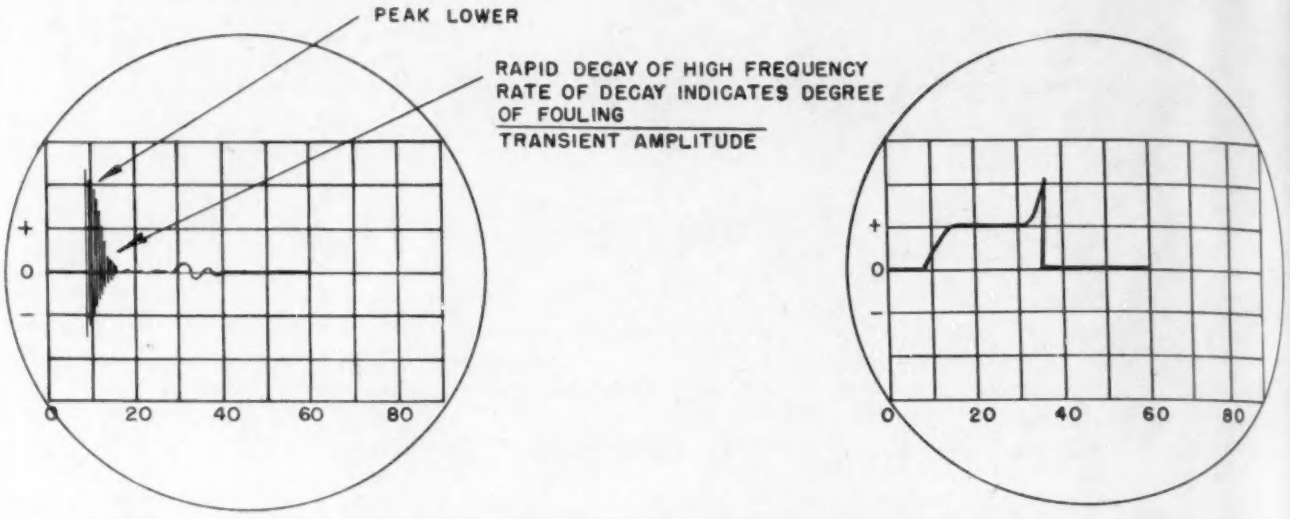


Fig. 2 – Each ignition trouble has a characteristic pattern on the indicator screen, easily distinguished from the others. The diagram at left is the pattern created by a fouled spark plug. The diagram on the right indicates an open primary condenser

ture of the voltage variation in the primary of the magneto. Vibration pick-ups on all cylinders of each engine permit vibration analysis by relaying the information back on the screen for study.

The analyzer will detect and predict many operational difficulties experienced with aircraft engines.

Ignition-system analysis is based on change in shape of the voltage-time diagram caused by deviation from normal operation. Each type of failure produces its own pattern and the differences are easy to detect. Fig. 2 shows how a fouled spark plug and an open magneto primary circuit appear on the screen. Other ignition-system malfunctions the analyzer will pick up are shorts in any part of the system, bouncing or improper adjustment of breaker points, too large or too small spark-plug gaps, and low-output magnetos.

Magneto synchronization and timing can be checked since the pattern's abscissa can be read in degrees of crank angle, a direct measure of magneto timing. Placing both the right and left magneto primary ignition pattern on the screen simultaneously will detect failure to fire respective spark plugs in synchronization and will determine the degrees of crank one magneto is leading the other – if such conditions exist.

Engine synchronization can be checked by locking the cathode tube horizontal sweep to No. 4 engine rotation as standard, then placing ignition energy from No. 1 engine on the vertical deflecting plates of the cathode ray tube. If No. 1 engine's pattern is stationary, No. 1 and No. 4 engines are synchronized. If the ignition pattern moves to the left, No. 1 engine is oversped; pattern movement to the right indicates No. 1 engine is undersped.

Cylinder vibration on any engine may be selected by the condition-selector switch with the cycle-selector switch turned to any cylinder cycle event. By projecting vibration patterns on the screen for events such as exhaust and intake valve opening and closing and combustion detonation, troubles such as sticking valves, valve bouncing at seating, parts failures, and detonation can be detected.

Analysis can also be made of hydraulic and electrical accessory faults. Voltage energy from electrical accessories and voltage converted from hydraulic pressure by an electrical pick-up are applied to the indicator's vertical deflection plates. Resulting pressure or voltage-versus-time curves show existing accessory malfunctions.

Temperature Offers Clues

From a discussion

By W. V. HANLEY
Standard Oil Co. of Calif.

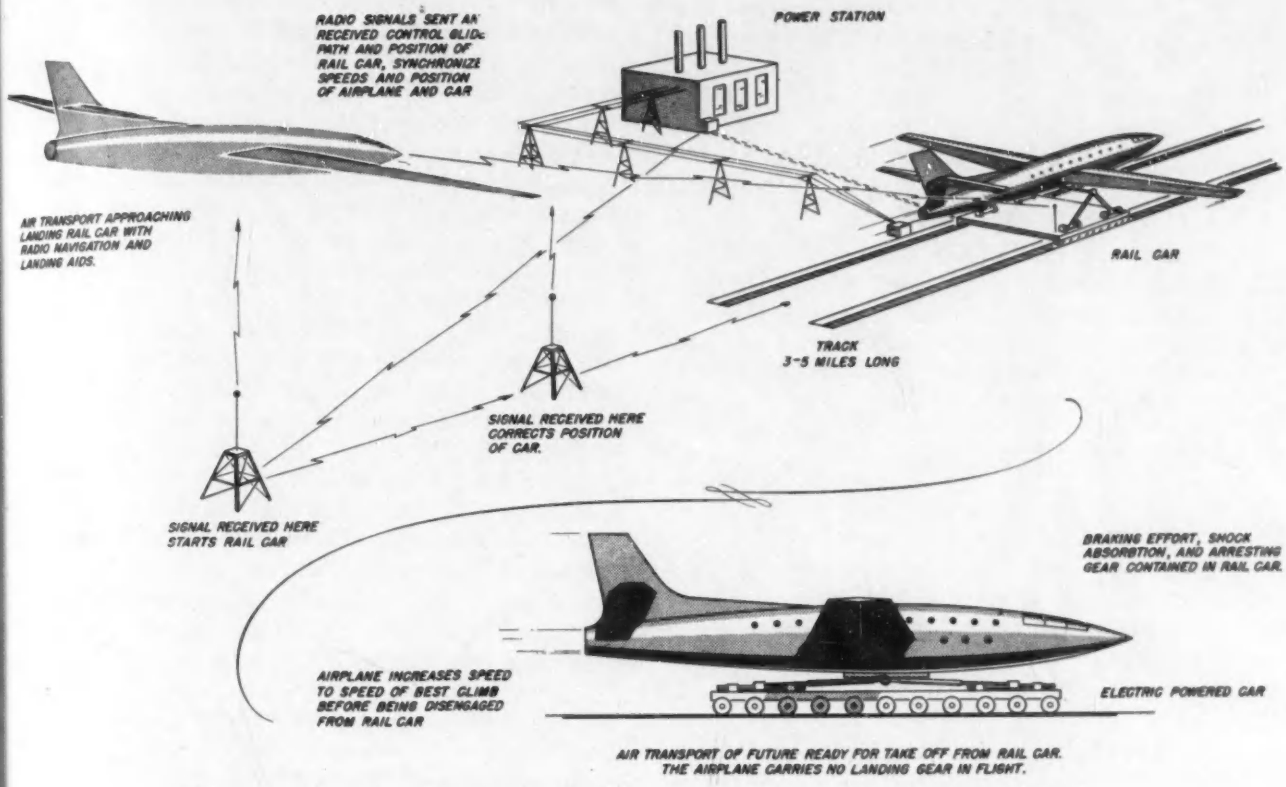
MEASURING temperatures as a means of detecting unpredictable and erratic preignition failures is the principle on which Standard Oil of Calif. built a preignition detector for engine trouble-shooting in flight.

This instrument indicates 150 temperatures within 5F accuracy several times per sec. It will give the maximum temperature continuously on a conventional aircraft temperature indicator regardless which of the 150 temperatures is maximum at the moment. Any thermocouple other than the one that is maximum can be read by turning a selector switch to the desired position.

A warning bell or light operates whenever any of the 150 temperatures exceeds a preselected value. If any component fails, the warning light and bell are actuated. Fire warning and detection also can be incorporated in this device.

Total weight of the equipment for 144 temperature points plus the fire warning and maximum temperature warning device is less than 100 lb. Total current drain is 1.5 amp. at 24v.

Idea to Aid Landing and Take-Off


RADIO SIGNALS SENT AN RECEIVED CONTROL GLID: PATH AND POSITION OF RAIL CAR, SYNCHRONIZE SPEEDS AND POSITION OF AIRPLANE AND CAR
POWER STATION
AIR TRANSPORT APPROACHING LANDING RAIL CAR WITH RADIO NAVIGATION AND LANDING AIDS.
RAIL CAR
TRACK 3-5 MILES LONG
SIGNAL RECEIVED HERE CORRECTS POSITION OF CAR.
SIGNAL RECEIVED HERE STARTS RAIL CAR
BRAKING EFFORT, SHOCK ABSORBTION, AND ARRESTING GEAR CONTAINED IN RAIL CAR.
AIRPLANE INCREASES SPEED TO SPEED OF BEST CLIMB BEFORE BEING DISENGAGED FROM RAIL CAR
ELECTRIC POWERED CAR
AIR TRANSPORT OF FUTURE READY FOR TAKE OFF FROM RAIL CAR. THE AIRPLANE CARRIES NO LANDING GEAR IN FLIGHT.

Artist's conception of a launching and landing system for high-speed transport aircraft in which the landing gear remains on the ground

EXCERPTS FROM A PAPER BY

LEWIS A. RODERT*

PRESENT methods of launching and landing of aircraft impose serious penalties in efficiency of operation, and unless improvements are made the normal technical progress of the industry will be retarded. It is important therefore, that new methods be investigated which give promise of making possible improvements in operational efficiency.

Use of the conventional retractable landing gear imposes a penalty on the efficiency, usefulness, and safety of many current airplane operations. In the future, however, if the high air speeds commonly anticipated by the industry are achieved, the method of launching and landing may become a critical factor in design.

This discussion is concerned with a launching and landing method which has been independently conceived by various engineers during the past several years but which has not yet been investigated or developed. The purpose of this discussion is to describe one possible version of the method and to encourage the research and development which are needed to establish the practicability of the scheme, and to stimulate its eventual use.

Most early airlines have been over routes, along which the distance between stations is not great, and which allow a profitable pay load. In most cases the route afforded emergency airports on which a safe landing could be made. Although the attachment of the landing gear caused a loss in payload of about 10% of the gross airplane weight, hauling it along was tolerable because the operation was a profitable one, irrespective of the

* Paper "Landing and Launching of Transport Aircraft from Moving Land Vehicles," was presented by Lowis A. Rodert, National Advisory Committee for Aeronautics at the SAE National Air Transport Engineering Meeting, Chicago, Dec. 3, 1946.

penalty. Landing gear also was useful in emergency landings required at an intermediate station.

Present and future airlines include many routes along which the distance between stations is very great. Such routes will require a subsidy from the remainder of the airline system or the government. A significant number of these long-distance hauls are over water or barren lands and therefore represent operations in which the landing gear is useful only at the end terminals. Other long hauls with marginal pay loads may be found on routes along which airports may exist but no landings are made because of the traffic density and possible delays at the intermediate stations.

An attempt therefore should be made to develop other methods which will permit the landing gear to be left on the ground because a saving of the weight of the gear and added weight and complication of the airplane structure would be realized by such a method.

Cites Penalties

Advantage of high air speeds increases as the distance between stations is increased. Fairly rigid relations exist, however, for optimum efficiency, between the cruising speed and minimum speed, and the latter is closely related to the launching and landing speeds. A penalty in operational efficiency, as well as structural complication, is imposed on an airplane if the cruising speed is increased and the landing speed is held to safe limits for the conventional gear.

Present research on aircraft powerplants will undoubtedly make possible air speeds very much above current cruising values. If the landing speed is not increased however, all of the advantage of this possible speed increase will not be realized. As the cruising speed increases beyond the subsonic range this problem becomes critically urgent because of the narrow band of useful angles of attack characteristic of supersonic airfoils.

It is probable that future high-speed long-range airplanes will employ jet-type powerplants, the static thrust of which is low. Future launching methods should therefore include provision for assisting the airplane propulsion with ground-based equipment during the take-off operation.

The use of jet propulsion will eliminate the propeller and deprive the airplane of the braking effort afforded by reverse-pitch propellers. Future methods for landing large, high-speed transport airplanes should also provide, therefore, for braking and the deceleration of the aircraft to a stop.

A method for launching and landing is needed, therefore, which 1, eliminates the airborne gear and increases the pay load, 2, allows a higher, safe take-off and touch-down speed, and 3, provides assisting thrust during the take-off run, and braking during the landing run.

A method is here proposed for study and development in which the airplane is launched from, and landed on, a railborne vehicle. The rail car should provide assisting propulsion during the launching maneuver, braking during landing, and shock absorption for the touch-down impact. The launching and landing of the airplane by the use of the vehicle would be possible by either manual or automatic operation.

The history of assist launching of aircraft is dated from the beginning of the airplane. The Wright brothers used rails and assisting forces. Declined runways, cable and falling weight, and pneumatic catapult are some of the devices used early in aviation for providing assisting power for take off. The glider pick-up by an airplane is a recent development. Jet assists are coming into very common usage. The Navy Bureau of Aeronautics has announced a new device, the Electropult, which is capable of launching full-size airplanes in four seconds. A stunt, seen occasionally at air shows, is the take off and landing of a small airplane from the top of a rapidly moving truck. Many other forms for assisting the take off and a few for improving the landing have been proposed.

Equipment carried aloft but which is used only during the launching and landing of common land-based airplanes now in use, includes the landing gear, tires, tubes, wheels, brakes, retraction motors, hydraulic pumps, hydraulic tubes, hydraulic fluid, signal equipment, retraction controls, brake controls, landing gear compartment doors and door-operating devices. The elimination of this equipment will permit smaller nacelles, simpler construction of the nacelles, wings, fuselage, and empennage. If the airplane is supported by the landing platform on the bottom of the fuselage and over a large area of the structure, the structural penalties of concentrated landing-gear loads will be eliminated which will permit a further simplification of the structure.

Seeks Safe Method

Maximum cruising efficiency requires a higher wing loading and, therefore, a higher cruising speed. Along with the higher cruising speed goes higher climbing and gliding speeds. If the launching and landing system is to impose no penalty whatsoever upon the cruising efficiency, the launching speed should be at the most efficient speed for climbing to cruising altitude, and the landing speed should be at the most efficient speed for a normal descent. It is apparent therefore, that our search for means of improving the airplane should be in part, a search for safe means of increasing the launching and landing speed.

As a vehicle for hauling cargo and passengers,

the airplane should be a high-wing monoplane and the floor of the fuselage should be flat and strong. The use of a high-wing monoplane and the present type landing gear places a serious penalty in the structural weight of both the wing and landing gear. A low- or mid-wing monoplane therefore has come into common use. Since the bottom of the fuselage exterior now serves only as an aerodynamical fairing, a double structure is used which is expensive and heavy. Attempts to regain some of this disadvantage by using the space between the fuselage floor and the outer skin as a cargo hold have not been impressively successful because the space does not have a good shape for such use.

The proposed launching and landing system could make possible the use of a high-wing monoplane and gain the aerodynamic advantages inherent in this design. Since the bottom of the fuselage is to be employed as the landing surface, it will have to be strong and probably flat and thus possess characteristics more compatible with other design requirements. The proposed method of landing is offered as one which will allow a higher landing speed and therefore a lower range of altitude angles during flight and landing.

The design of airplane propellers is made increasingly difficult by the increased blade-angle range which accompanies increasing ratios of cruising speed to landing speed. Furthermore, a propeller is more difficult to design, which must provide the starting thrust of unassisted take off and reversed pitch braking, the latter involving both structural and mechanical problems. A launching and landing system in which higher launching and landing speeds are safely permissible, and in which launching thrust and landing braking are provided in a land rail car, will greatly simplify the design of airplane propellers.

Today's reciprocating airplane engines have been specially developed to meet the requirements of the unassisted take off of most airplanes. Turbo-jet and ram-jet power plants require assistance if a high margin of safety is to be maintained and if the maximum range qualities of the airplane are to be achieved. The turbine-driven propeller also requires assistance because of the mechanical failures which are experienced when over-rated thrust at low speeds is employed.

Proposal Fits Jet Power

The propeller jet is most efficient when the craft has reached a speed at which the efficiency of the jet becomes significant. The continued development and use of the new high-speed type power plants as well as the present reciprocating engine require, and are greatly aided by, the proposed launching system and its inherent assisting features.

Today's airport at best is a compromise, and not a happy one, between the requirements for multidirection runways arising out of variations in wind direction, the bearing strength of the landing surface, runway length, a system of taxi strips that will handle all traffic irrespective of wind direction or traffic volume, various other factors, and how much money the "city fathers" are willing to spend. Nominally short main-line hauls and feeder-line operations may be able to function economically and effectively in spite of the handicap resulting from such a compromise. The marginal long-range operation requires a better treatment of the terminal problem.

Large Yaw Angle

Multidirectional runways are required because of the type of landing gear employed in present-day airplanes and because of the large ratio of wind speed to landing speed. The proposed launching and landing system would allow a large angle of yaw to exist between the longitudinal axis of the airplane and the direction of motion of the aircraft and car. This angle would be decreased as the speed of landing is increased.

As the weight of aircraft increases, it is doubtful if the concrete runway surface would be found the least expressive means of supporting this weight. A railway type of construction has the capacity to support a much greater concentrated load. Being limited in width, it appears that keeping the system in operation during heavy snow falls would be more easily accomplished than cleaning snow and ice from the present type of runway.

By supporting the airplane on a rail car, its movement along an orderly traffic path at the terminal, and over a system of tracks which are independent of the launching and landing right of way should not prove a difficult problem. The cargo and passenger area could then be completely free of engine noise and propeller and jet blasts.

Landings at sea and in wilderness regions are particularly hazardous with today's land based planes because the fuselage is not strong enough in the right places. Landing the large high-speed transports of the future can be accomplished with safety only on a carefully constructed runway. An emergency landing in an open field isn't going to be a landing – it will be a "splatter." An incidental advantage which will come from the proposed launching and landing system would be a stronger fuselage and therefore a safer "belly landing" in the event of an emergency landing.

Important maintenance problems arising directly out of the present type of landing gear originate from the following causes:

1. Wheels, shock strut, and retraction gear wear.
2. Excessive stresses in the landing gear and adjoining aircraft structure.
3. Wear of tires, tubes and brakes.
4. Wear and failures in hydraulic lines, pumps,

pressure regulators and control equipment.

5. Engine wear due to the use of rated take-off power.
6. Damage to airframe and landing gear from ground-handling tractors and other equipment.

More Desirable System Needed

Objections point the way to a more desirable system, some of the features of which have already been given. Specified in greater detail, one possible system would be as follows:

The landing gear would remain on the ground in the form of a powered rail car on a track, perhaps several miles in length.

The airplane would rest and be secured with the fuselage bottom on a cushioned receiving platform on the top of the car.

Launching would be accomplished by bringing the car and aircraft up to climbing speed when the airplane would be released for flight.

Landing would be accomplished by flying the craft to a position over the platform of the car, when the airplane would be arrested and stopped.

Power required for launching, above that provided by the airplane engines when set for climbing would be provided by the car.

Braking force to slow the airplane to rest would be provided by the car.

Movement of the airplane to the passenger and cargo docks and repair hangars would be by the use of a car on a secondary rail system.

Control of the airplane in the launching or landing maneuvers may be by either manual means or automatic pilot.

The approach of the airplane to the moving car would be maneuvered by automatic direction control which operates on a homing principle. This system would give a flared landing if the airplane "homed" on the car.

One direction of the railway would be provided with operation allowable from either end. Side wind landings would be allowable if the landing speed is high or if the arresting gear could be "yawed" to conform to the direction of the longitudinal axis of the airplane.

The path of the airplane would be directed by glide path control equipment. This equipment could be operated by a two-element automatic radio compass which is made to "home" on an antenna on the rail car. The power of the airplane engines would be automatically or manually adjusted to give a constant airspeed in the glide until the airplane has been arrested by the landing platform, at which time the engines would be stopped.

Advantages of such system are:

Greater pay load is possible because landing gear, excess installed power for launching, hydraulic and other accessory equipment, and excess wing structure are eliminated.

Greater pay load is possible because a higher wing loading is possible as a result of higher safe landing speed, and the fuel consumption would be lower because of smaller nacelles, less wing area, and the possible use of better wing sections and airplane types.

Economically profitable long-range high-speed flight would be brought near to realization because the propeller-jet, jet type, and other new power plants could be more readily applied.

The economy of operations would be improved because of reduced need for maintenance on flight equipment and greater permissible flyable time for the airplane.

A single-direction runway would be required, thus reducing the terminal cost and simplifying surface and aerial traffic patterns.

Long-range military and commercial operations otherwise impossible could be accomplished.

In order to bring about the use of the launching and landing system herein proposed, it is necessary to first establish that the maneuver of landing a large high-speed airplane on a moving rail car can be safely accomplished. This question has two parts. One is concerned with the controllability, the other the maneuverability of the airplane. In this case the control involves not only the mechanical flight equipment but also the electrical and electronic devices which are required to bring the airplane into a proper position for the arresting operation. The question on maneuverability is concerned with whether or not the airplane can be made to respond properly to the control movements.

Problem Is Fundamental

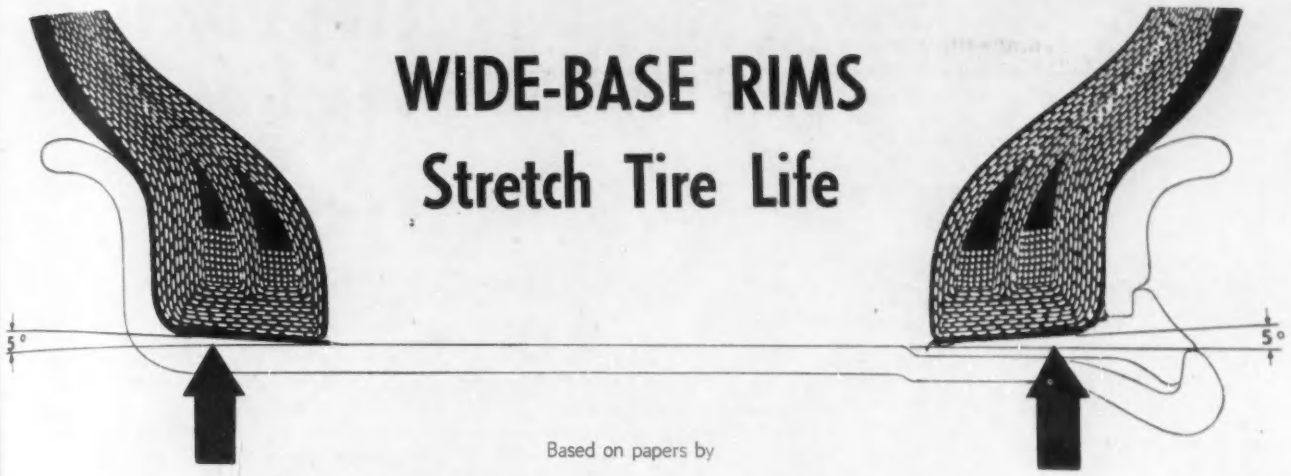
These problems are fundamental in nature and require careful study before the development of the launching and landing system should be undertaken.

In consideration of the need for maintaining a foremost position in the applied sciences of aeronautics all proposals for improvements in performance, economy, and utility must be scrutinized.

The rewards which may be achieved by an improved launching and landing system are very great, greater in fact by far than can be achieved by any conceivable change in airplane configuration, or innovation in propulsional means.

It is the writer's hope that an interest in bringing about a major change in the method of launching and landing will be stimulated and that in the next few years a full-scale investigation will be undertaken to determine the practicability of some new method, perhaps not exactly as outlined here, but let us hope, one which eliminates at least the major problems attendant with the systems currently in use.

WIDE-BASE RIMS
Stretch Tire Life



Based on papers by

W. S. BRINK
E. P. GOHN
G. M. SPROWLS
R. B. WUERFEL

IMPROVED tire life and performance reported by many truck and bus operators using wide-base rims justifies the switch to these rims, all four of these authors believe.

A survey of fleet operators the country over by Gohn brought in a flood of favorable reports. From a grocer in Harrisburg came word that wide-base rims show a saving of 60% in 1946 over 1941 despite higher unit costs for tires and mileage. A baking company delivering retail products in New York City advised that lack of new equipment during the war forced modification of 4.00 full-drop center rims to 5.50 semi-drop center rims by cutting and welding. This mechanical change resulted in (1) 25 to 33-1/3% increased mileage, (2) simplified mounting and demounting without damage to the tire at the bead or in the carcass, (3) improved roadability, eliminating side-sway tendency, and (4) improved steering characteristics due to elimination of side sway and vehicle roll tendency.

Said a milk company in Albany: "We noted an immediate reduction in blow-out occurrence. . . . We have less trouble with synthetics (mounted on wide-base rims) than we had with natural rubber operating on the original rims." A Buffalo delivery truck operator found tire mileage increased 40% over the narrow rim mounting with virtual elimination of road service.

Broad Test Program

Selection of a 70% rim width ratio – ratio of distance between rim flanges to tire cross-section under normal inflation pressure – was the result of a broad testing program, declares Brink. Experience with these new rims on military vehicles during the war substantiated the advantages revealed in tests.

Truck manufacturers agree that wide-base rims offer a number of virtues, continues Wuerfel. Old-style flat-base rims – especially with larger size tires – were not satisfactory. The problem of front-end disturbance is attributed to the tire-bead clearance at the bead seat.

Papers on which this article is based were presented at the SAE Metropolitan Section on Nov. 11, 1946. They are: "Truck and Bus Rims – What Corrections and Changes Were Necessary," by W. S. Brink, Firestone Steel Products Co.; "Operators' Experience with Wide-Base Rims," by E. P. Gohn, Atlantic Refining Co.; "Problems of the New Tire and Rim Standards – Wide-Base Rims from a Tire Viewpoint," by G. M. Sprowls, Goodyear Tire and Rubber Co., and "Wide-Base Rims – From a Vehicle Viewpoint," by R. B. Wuerfel, Chevrolet Motor Division, GMC.

Important in the wide-base rim is the 5 deg tapered bead seat provided, as shown in the illustration above, which does away with disturbance caused by flat-bead clearance. The tapered bead seat provides a compression-tight tire fit instead of the loose fit with old-line rims. In doing so, the taper performs two functions: First is positive centering of tire on rim, minimizing runout and reducing vehicle-control disturbance from diameter irregularities in the tire and rim assembly. Second is moving of the rim diameter tight up against the tire bead; this stops rocking and movement up and down the rim-flange face that chafes the bead and causes it to fail.

Also side walls are straighter and stronger, not bulged or bellied. Tires flex less because side walls act like columns rather than cantilevers. Tires run cooler, a decided advantage with synthetics. It is noted that treads make full, even road contact and improve tire stability because of the broader base and the 5-deg tapered bead-seat compression-fit. Tire air volume is increased directly under load, helping take road shocks.

Wide-Rim Program Approved

Sprowls reports that exceptionally good performance of wide-base rims, producing a substantial cost saving, prompted the Tire & Rim Association to approve a wide-rim program as permissible practice for tires on trucks and buses in highway service. The program offers rim-width increments of ½ in from the 5.00-in. through the 9.00-in. rim. It provides that new tires fit the old rims and that old tires fit the new rims with perfect interchangeability.

Although many operators find that change to wide rims entails only a new rim size, Wuerfel points out that truck design changes may be necessary to accommodate wide rims.

In going from 5.00S to 6.00 rims, steering arms had to be bent inward (offset ⅜ in.) and the tie rods shortened ¾ in. for rim clearances. Steering geometry was found to be changed in that the inner front wheel turned more sharply in relation to the outer wheel than before.

Wide rims may extend over the brake flange plate and cut off air circulation – wherever brake drums are large in relation to rim diameter – causing excessive heating of the brakes. This may require moving some brake assemblies inward and as close to the rear springs as possible. For larger trucks using 10.00 tires and larger, keeping within the 96-in. overall allowable width is a problem since wider rims increase tire section width and wider tires require greater dual spacing.

In general, the smaller the truck, the less likelihood for design changes to accommodate wide base rims for correct tire sizes involved. But regardless of the modifications required, potential economies justify use of wide-base rims.

Must Cut Ground Time For Optimum Plane Use

Digest of paper

By HAROLD R. HARRIS

American Overseas Airlines, Inc.

IN 1946 the average commercial plane spent 8 hr in the air, 16 on the ground. Why can't this proportion be reversed in the interest of better utilization of equipment? Harris asks. If it were, the number of ships could be cut in half, and personnel greatly reduced.

Harris pointed out that: principal limitations to realization of complete efficiency. Many are greatly reducible:

1. Safety limitations.

2. Payload handling: loading and unloading are far from smooth. Main bottleneck is routine paper work. (Each foreign departure from LaGuardia requires 273 documents without cargo; each piece of cargo adds 14 more pieces of paper.)

3. Schedule crowding: concentration in popular travel hours leaves early morning hours unused and uncongested.

4. Terminal congestion: limited ramp space and gate facilities, as well as confusion in Government weather, immigration, customs, and other offices slow down operations.

5. Modifications: aircraft never start off on the right foot because operator specifications are not definitive, manufacturers' models not as sturdy and simple as they might be.

6. Spare parts: inadequate anticipation of long-range requirements means improper provision for possible needs, lost time on the ground. (Paper, "Method of Obtaining Optimum Aircraft Utilization – Domestic and Overseas," presented at SAE National Air Transport Engineering Meeting, Chicago, Dec. 2, 1946.)

Air Safety and Reliability Look Up With New All-Weather Flying Devices

Digest of paper

By W. E. RHOADES

Air Transport Association of America,

and GEORGE COMSTOCK

Airborne Instruments Laboratory, Inc.

SAFE, reliable operation of aircraft under all weather conditions is the major objective of air transportation. Although complete answers cannot be given to many future policies and developments now in progress, trends in both areas make us more optimistic than we could have been six months ago.

Any attempt to model a future system of air transport on the present framework is futile, but we must immediately implement it with available useful devices. These include automatic direction finding locating stations (GCA) adequately monitored instrument landing systems (ILS), high intensity runway lighting, and adequate approach lighting.

Little radar equipment can be used in commercial operations exactly as it was in military service. During its trial years in civilian use electronic equipment will supplement, not supplant, other proved sources of navigation and traffic control data.

In the foreseeable future it will not be possible to attain the frequency of operation at any given airport under full instrument conditions now possible under ceiling and visibility unrestricted (CAVU).

Eliminating Congestion

Traffic jams will continue during bad weather near congested terminals until they are given authority and the means of rejecting flights prior to departure from their last landing points on the basis of an acceptable arrival rate.

Safety requirements also demand more extensive use of the abundant

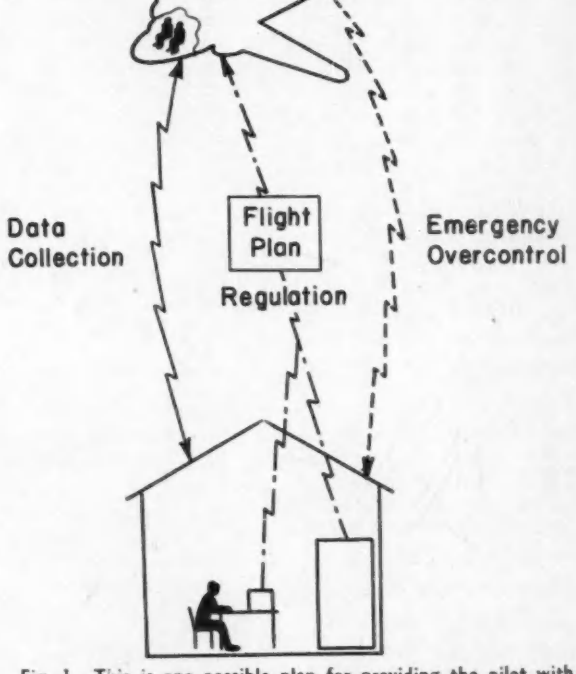


Fig. 1 – This is one possible plan for providing the pilot with air navigation and traffic control information. In this system, the pilot is given the proper navigation and communication equipment, being safeguarded against collision by proper separation from other aircraft in either space or time

air space. No system wi work unless the pilot is kept fully informed. One such plan is shown in Fig. 1.

The most urgent need is for a common meeting place at the technical level where the Government and private agencies concerned can argue their varying viewpoints, cast their votes, and have the assurance that a majority – not necessarily unanimous – opinion will be asserted. (Paper entitled "A Quantitive Approach to All-Weather Flying," presented at SAE National Air Transport Engineering Meeting, Chicago, Dec. 4, 1946.)

Trucks Keep Pace With Specializing Economy

Digest of paper

By B. B. BACHMAN

The Autocar Co.

TRUCKS have been an important part of the expanding American economy. Needed to transport people and commodities between already established communities, they have in their turn made a demand for better roads, and roadbuilding has meant the opening of new areas, Bachman says.

As requirements have transcended the mere supplying of basic foods and materials, trucks have been developed for a multitude of diversified uses. In some cases chassis and bodies are completely designed for special service; in others, standard chassis are modified and equipped with special bodies.

Fields of application are boundless. Specialized trucks have found use in almost every area of modern productive effort. Retail delivery trucks vary from those that carry department store packages to special models with power-operated dump bodies and tanks with pump delivery for coal and fuel. Intercity hauling uses tractor semi-trailer combinations with numerous different bodies easily attached. Types extend from rack side or van type bodies for crated or baled goods, through dairy or petroleum tanks to those for livestock.

Public Utility Uses

Highway maintenance and construction and public utilities have been responsible for bodies to perform such operations as concrete mixing, disposal of snow and garbage, drilling post holes, stringing telephone lines, and fighting fire. Off-the-road vehicles – unlimited by legislative restrictions – are tremendously important in oil fields and mining work. (Paper, "Diversification of Truck Use," presented at SAE Detroit Section, May 20, 1946.)

HELICOPTER CUTS TRAVEL TIME

Fig. 1 – In a series of air mail tests in Los Angeles between the airport and the Terminal Annex Post Office shown, the helicopter proved it could speed air mail delivery at no increase over the present 5¢ air mail rate

Digest of paper

By E. J. NESBITT

Sikorsky Aircraft,
Division of United Aircraft Corp.

HELICOPTERS will bring airports closer to destinations of passengers and cargo carried by large fixed-wing aircraft, Nesbitt declares. They will supplement rather than compete with the service of high-speed transports. Highlighting helicopter potentialities, he demonstrates that:

Average traveling time from the center of a city to the airport in 22 of the largest cities is 40 min, over an average distance of 8.55 miles, and for a fare of about 99¢. This seriously handicaps the airline operator competing with ground transportation for short distance operation. Shuttling from city center to the airport by helicopter, however, the 8.55-mile average distance could be covered in 8 min. Even allowing an additional 5 min for transfer of baggage, the helicopter-airplane combination is speedier than train or automobile for distances as short as 28 miles.

Principal cargo use of helicopters in supplementing air transport – already in effect – will be in carrying air mail and air express. Tests both in Chicago and Los Angeles showed the cost of helicopter operation to be well within the economy range of 5¢ air mail.

In both tests, helicopters advanced air mail deliveries from 4 to 24 hr. Evidence of this time saving were air mail letters post-marked 10 p.m. in New York that were delivered to the addressee in Chicago at 6:20 a.m. Fig. 1 shows one of the month-long helicopter tests at Los Angeles.

Schedule regularity is another virtue of helicopter operations. In recent Chicago tests, overall average for schedules maintained was better than 98% for over 8000 miles flown and 800 scheduled landings and take-offs through plenty of bad weather.

Helicopters will also provide passenger shuttle service. Many people have already paid a premium for being whisked by helicopter to airports and race tracks. A number of applications have been filed to link suburban towns with large municipal airports by helicopter.

While these probably will be the main services of the helicopter in air transport operation, it will be called upon for varied tasks such as rescue work, crop dusting, and forestry, conservation, and geological surveys. (Paper entitled "The Helicopter and Its Relation to Air Transport Operation," was presented at SAE National Air Transport Engineering Meeting, Chicago, on Dec. 3, 1946.)

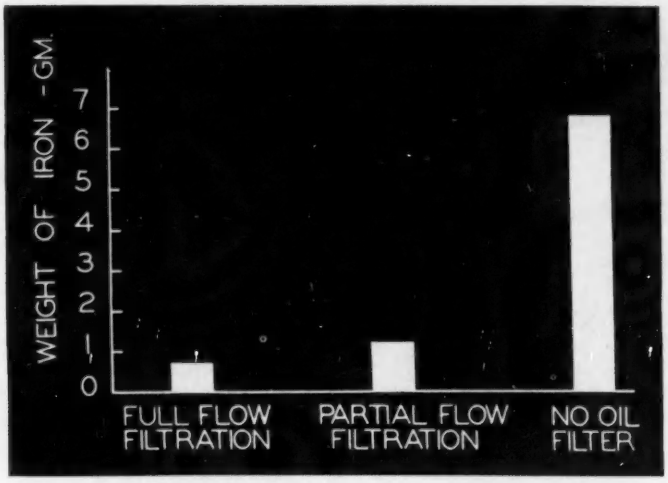


Fig. 1 – Effectiveness of oil filtration in reducing engine wear is demonstrated by this chart showing average increase in the weight of iron in engine drain oil and washings

Engine Wear Wanes With Oil Filtering

Digest of paper

By NORMAN C. PENFOLD and DONALD S. GRAY

Armour Research Foundation

THAT lubricating oil filtration will reduce engine wear was demonstrated in extensive diesel engine tests under controlled conditions, report Penfold and Gray. Discussing results of their investigations, they reveal that:

Wear rates of a 4-cyl Caterpillar diesel for three conditions – no oil filter, partial flow, and full flow filtration – were determined by measuring the amount of metallic particles retained in the filters, in the drain oil and washings, and the increase in iron content of the lubricating oil.

Test results demonstrated that oil filters do influence engine wear. Wear rates were greatest with no filter and full flow filtration was found to be more effective than partial flow. Fig. 1 illustrates these results graphically.

Observers believe that this wear reduction is accomplished through the labyrinth action of the filter in removing iron rubbed from the upper cylinder region as the oil passes through the filter. This prevents the iron from being returned in the oil to the upper cylinder region to act as an abrasive.

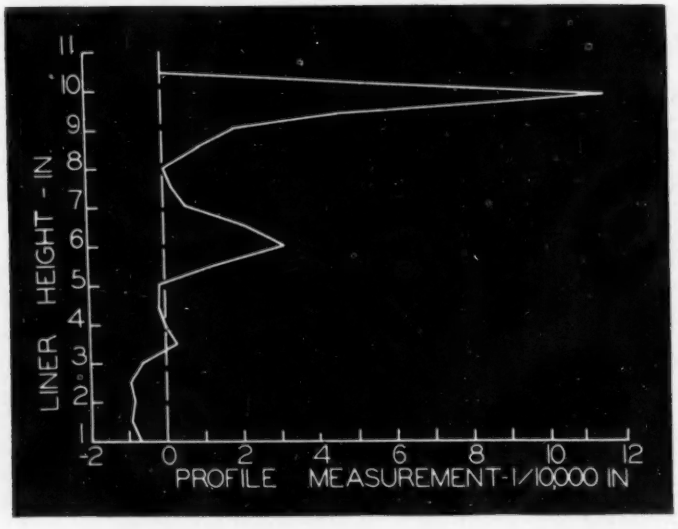
Although the mechanism by which the filter removes the iron from the oil is not fully understood, electron microscope studies lead to speculation that metallic iron particles are carried in aggregates of graphitic carbon. Clogging of filter surfaces with this carbon as well as other oil contaminants also may be responsible for removal of the iron.

Whereas metal removed from piston rings – considered the best yardstick for measuring engine wear – can be very accurately determined, metal removed from the cylinder wall is practically impossible to measure. A cylinder profile-measuring gage was designed to do just what its name implies to eliminate errors introduced with conventional diametral measuring gages.

Measurements of liner wear in cylinder No. 2 for the "no-filter" condition, shown in Fig. 2, are typical of the pattern for all cylinders.

Results of these tests point to the need for further investigations of wear rate trends resulting from different types of filters, variable engine operation, and varying additive concentrations. (Paper entitled "Oil Filtration and its Effect on Engine Wear," presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 8, 1946.)

Fig. 2 – These cylinder lining wear measurements were made with a specially devised instrument for operation without a filter. The dashed ordinate represents zero wear. Slight "negative" wear at the bottom of the liner probably is due to warping



Adequate Filtering Adds to Bearing Life

Digest of paper

By C. A. WINSLOW

Winslow Engineering Co.

FILTERS have reached an eminent position in modern engines, Winslow states. Light weight modern machinery, with its highly stressed working surfaces, relatively close bearing clearances, and greater loads with high speeds, must have plentiful supplies of cool, clean lubricant. He shows that:

Filter kind and size are influenced to a large extent by oil velocity and viscosity. Filter must have a high enough flow rate to pass all oil from the pump to the bearings and back to the crankcase. If flow is too slow, cleaning effect will be lost by bypassing.

Winslow's experience has been that slow flow rate, one-pass, dense filters may be used successfully if large enough, but that a high flow rate filter best protects bearing surfaces.

Best and most-used present filter, he said, is the full-flow inline type fed by a pressure regulator and supplemented by an oil cooler between filter and bearings. If the filter is large and allows free flow, and cooler is adequate, a clean, ample, cool supply of oil will be delivered to bearings – insuring adequate lubrication and long bearing life. (Paper "The How and Why of Strainers, Screens and Filters as Applied to the Fuel and Lubricating Oil Systems of Engines," presented at SAE Northern California Section, April 24, 1945.)

Jets New Twist On Old Phenomena

Digest of paper

By H. G. JONES, JR.

Office of Chief of Ordnance

JET PROPULSION in any form is simply Newton's law – for every action there is an equal and opposite reaction – at work, says Jones. Outlining operating principles of turbo jets, ram jets, pulse jets, and rockets, he points out that:

Jet units shorten the process of energy transformation compared to conventional reciprocating engines. Chemical energy of the fuel is transformed into heat and then directly into kinetic energy of flow, by-passing the intermediary transformation to mechanical work.

Turbo-jet engine components are: a source of fuel; and a means of injecting it; source of oxygen for combustion; a combustion chamber; a tail pipe, and a means of compressing the air – either an axial flow or centrifugal compressor driven by a turbine. Other parts required are an igniter to start the fuel-air mixture burning, control valves, and a method of starting the rotor and accelerating it up to idling speed – sometimes as high as 3000 rpm.

Although hydrocarbon fuels such as kerosene and light diesel oils have been used, gasoline appears to be most suitable because of its high heat value and availability.

Major limitation in improving performance is metallurgy. Turbine wheel and combustion chamber materials are limited to about 1380F for reasonable operating life. If this temperature could safely be increased, fuel-air ratios could be increased to produce greater thrust without increasing size or weight of the engine. Velocity of the gases, which determines thrust produced, is limited by the permissible temperature rise.

Ram jets are simpler than turbo jets since they have no compressor, no turbine, and no accessories such as a starter and lubricating pump. Air at supersonic velocity enters the ram jet intake and passes through a subsonic diffusor where the velocity is reduced and pressure increased. Ram jets do not have rigid temperature limitations, but specific fuel consumption is high.

This powerplant must be accelerated by a rocket to a velocity where combustion becomes self-sustaining. It is particularly well-suited to propulsion of long range missiles.

A pulse jet is a modified form of ram jet. Whereas the ram jet operates in the supersonic velocity region and thrust is delivered in a continuous jet, the pulse jet operates in the subsonic zone with thrust coming in intermittent jets. Its only moving parts are the air flap valves.

Fuels ranging from bunker fuel oils to high grade gasolines can be used. Simplicity of construction and absence of metallurgical limitations point to possible applications in the subsonic velocity range.

Carry Own Fuel

Turbo, ram, and pulse jets are dependent on surrounding air for oxygen whereas rockets carry their own source of oxygen for combustion. Solid fuel rockets are simpler than the liquid fuel types because all fuel is carried in the combustion chamber – virtually a self-contained heat engine.

The solid fuel rocket is simple in construction. Short burning time – from less than 1 sec to about 1 min – requires no cooled nozzle. Absence of moving parts means no lubricating problems.

Liquid fuel rockets must contain, in addition to the combustion chamber, tanks for holding the supply of fuel, and a pressure system (pump or gas-generating device) to force the liquid from the containers into the combustion chamber.

Solid type rocket fuels are of nitrocellulose or nitroglycerin as main ingredients with other chemicals added for stability in storage and smoothness in burning. Liquid types are bifuels; one an oxidizing agent and the other a fuel which, when mixed, will support combustion.

Summary of all these jet engines compared for speed range and specific fuel consumption is given in Table 1. (Paper entitled "Types of Jet Propulsion," was presented at SAE Washington Section, on Nov. 12, 1946.)

Table 1 – Comparison of Jet and Reciprocating Engines

Engine Type	Speed, mph	Maximum Altitude	Specific Fuel Consumption	Specific Weight – lb of Dry Wt per lb Thrust
Reciprocating engine w/supercharger	500	60,000	0.55	1.0
Turbo Jets	300-700	60,000	1.1	0.7
Pulse Jets	200-1200	70,000	4.0	0.5
Ram Jets	1000-3000	70,000	3.3	0.2
Rockets	1000-3600	Infinite	15.0	0.15-0.30

Surveys Strides in Hand Tool Industry

Digest of paper

By ALEX L. GRAY

Gray Forgings & Stampings

THE past quarter-century has seen great strides in the strength and design of mechanics' hand tools, Gray said. Today's streamlined hot-forged alloy steel sockets are a far cry from the original pressed steel ones that emerged with the first automobiles.

Sockets now come in about 150 different sizes, shapes and grades. They range in weight from ½ ounce to 6 or 7 lb, and can handle nuts from 3/16 in. to 3 in. or more. They may cost from a few cents up to $30. A modern mechanic using the right size socket and the proper handle can reach and loosen any bolt, in spite of size, tightness, inaccessibility, or limited turning space. These sockets and their attachments, Gray feels, are the backbone of the mechanics' hand tool industry . . . the real steel fingers of industry. (Paper, "The Steel Fingers of Industry," presented at SAE Canadian Section, Oct. 16, 1946.)

Car Heater Rating No Index of Capacity

Digest of a paper

By V. MATULAITUS

Eaton Mfg. Co.

EFFECTIVE rather than rated thermal capacity is the true yardstick for measuring a fresh air heater's ability to heat an automobile, contends Matulaitus. Advising engineers how to select car heaters, he observes that:

Proper evaluation of heaters can be made only by recognizing that nominal and effective thermal capacities are not directly related. For example, a heater with a 20,000 Btu per hr rating may give the same or better car warm-up time than a 30,000 Btu per hr heater. High nominal ratings can be deceptive.

Let's compare two heaters and see why this is so.

Heater "A" delivers 150 cfm of air at 140F with OF air entering the heater. This represents a nominal heater rating of 20,200 Btu per hr. Heater "B" delivers 250 cfm of air warmed from 0F to 115 F – a capacity of 29,000 Btu per hr. It would appear that "B" has nearly 50% greater capacity than "A".

However, only a portion of the heat imparted to the air by a heater can be regained as useful or effective heat.

For example, if reasonable passenger comfort is to be maintained, air delivered from the heater cannot be chilled much below 75F or 70F before it is discharged. So even if the heater raises the air from an initial temperature of 0F, the air subsequently may not be chilled to less than 70F.

Therefore the Btu equal to the temperature difference between 70F and the inlet air temperature to the heater is lost.

Assuming that a 75F temperature is maintained in the car, effective capacity of heater "A" shrinks from 20,200 to 9,400 Btu and that of "B" from 29,000 to 9,700 Btu. At this point both heaters have nearly equal heating capacities, despite the difference of almost 50% in nominal capacities.

Since these diminished capacities are but a little higher than that of the recirculating heater (in which the chilled air is reheated without introducing fresh air), justification for the added cost and complication of fresh air heaters seems to vanish. This is not the case. Fresh air heating is superior for these three reasons:

1. It practically eliminates all possibility of building up noxious fume concentrations to dangerous levels;

2. Windows are free from fog and moisture films and windshield deicing and defrosting is more effective;

3. Smoke and body odor are eliminated during winter conditioning.

In selecting a heater, many factors other than heating capacity must be considered and weighed to find the most desirable unit for each job. (Paper entitled "Thermal Capacity of Fresh Air Automotive Heaters," presented at SAE Detroit Section, on Nov. 18, 1946.)

Fleet Team Work Adds Tire Miles

Digest of a paper

By BEN SORCI

Sorci & Bryant

LONG tire life stems from an appreciation of tire problems in all departments of a fleet operation – from top management on down, contends Sorci. Describing how each phase of the organization bears directly on tire maintenance, he shows that:

Tire maintenance must consist of a plan formulated jointly by the policy makers, purchasing department, personnel office, operations, mechanical maintenance division, and the tire department.

Many fleet maintenance troubles – tires included – are traceable to vehicles not suited to the work performed. Instances are known where operators introduced lengthy semi-trailers with the fallacious idea that little additional initial investment and no extra operating expense will increase payload tremendously. By not keeping in mind his relatively light tractors, the operator found his trailer tires underloaded and his tractor tires and axles highly overloaded.

Trucks and trailers must be tailored to the operation. Accepting standard manufacturer's models because they cost less can be expensive over the long haul.

Niggardly purchasing departments can throw obstacles in the tire man's path. Five-ton jacks where ten-ton capacity is needed . . . small tube vulcanizing plates without thermostatic control . . . short supplies of poor quality . . . looking for "buys" in tires . . . are all false economies in purchasing. Good tire service cannot, in fact should not, be expected when such practices are followed.

Proper selection of drivers will pay dividends in tire performance. First effect of reckless use of equipment by "cowboy" drivers is felt by the tire department. Long before such a driver has a chargeable accident, he has caused premature death of many a tire.

Evils of a Budget

Budgeting of departments will always lead to group-wise competition to produce the most revenue at the least cost. Where the operations office is charged only with expense of loading, unloading, and driving and where maintenance is charged to other departments, the door is wide open for high maintenance and tire costs. More tons per load is the least expensive way of handling freight – but it leads to overloading and uneven load distribution, taking its toll of tires.

To make the tire preservation plan work, maximum weights on vehicle axles and tires must be established and then unselfish use of these capacities must be exacted from the operating department.

Misalignment and brake drag – chargeable to mechanical maintenance – take a terrific toll in rubber. Misalignment comes in many forms and each one must be given attention. Perfect alignment has been achieved when rotational planes of all wheels in a train have been coordinated and centers of all axles have been aligned to one another. Loose bearings and linkage of any kind produce a misalignment costly in tread wear.

The mechanic who sets up a new brake lining with a "little" drag (so that it will seat itself perfectly in several thousand miles to give drivers a high pedal immediately) is responsible for many thousands of miles scuffed off tires and a safety hazard as well.

The plan should include automatic checking and correcting of concentricity and squareness of brake drums and the use of proper lining for the job. A mechanic should be thoroughly trained in front-end alignment and the functions of various parts, as well as the reason for values given camber, castor, and king pin inclination.

If all these controls have been set up, the tire maintenance supervisor can do a real job by keeping abreast of latest developments and techniques and staffing his shop with trained, capable men. New tires should be inspected on a spreader to detect flaws and weaknesses. Tubes should be tested under pressure and inserted into tires on the spreader to keep out grit and other abrasives.

Speeding Repairs

A stitch-in-time-saves-nine policy should be adopted for cuts and sidewall abrasions. Tires should be removed for recapping before being rendered useless. A good time to remove them is when about 75% of the tread design is obliterated and about ⅛ in. of base rubber remains to protect the carcass.

The 100,000-mile tire is now within reach of any operator who plans his operation and instills the need for cooperation in all phases of his operation. (Paper entitled "Present-Day Tire Maintenance," presented at the SAE National Transportation & Maintenance Meeting, on Oct. 17, 1946.)

Bearing Formula Forecasts Life

Digest of paper

By R. R. ZISETTE

SKF Industries, Inc.

SLIPSHOD methods have become impossible in bearing selection. Wide usage and difficult performance requirements have made it a precise art. New concept of bearing life defines it as the number of millions of revolutions, or the number of hours of operation at a given speed, which 90% of the bearings will complete before perceptible signs of fatigue appear.

Zisette presented a formula which enables the designer to determine mathematically exactly what bearing is best for a given application, or, for a given bearing, to calculate life. Factors are desired load; dynamic specific capacity (or the load at which the bearing will have a life of one million revolutions); a speed factor and a life factor. (Paper, "Industry's Responsibility to the Engineer," presented at SAE Cincinnati Section, Oct. 17, 1946.)

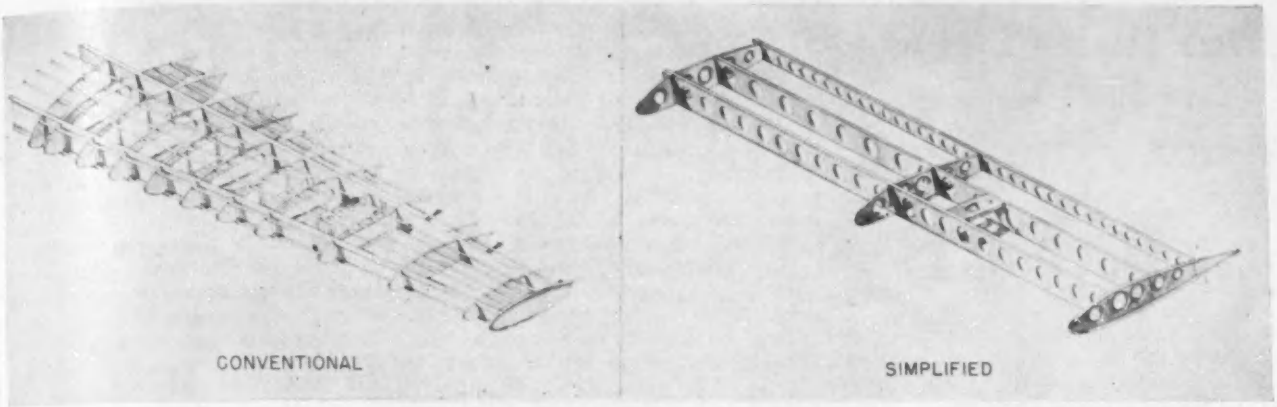


Fig. 1 – Design simplification of the conventional aircraft wing structure at left to the one on the right will reduce manufacturing cost and weight without reducing strength

SIMPLE DESIGN TRIMS PLANE COST

Digest of a paper

By A. F. BOYAJIAN

Republic Aviation Corp.

NONCONVENTIONAL airframe design of the Republic Seabee has reduced manufacturing costs and simplified structural elements without sacrificing structural strength, Boyajian reports. He shows that:

Orthodox design practice was sound for fabric-covered planes, but adds unnecessary dollars and pounds to present-day metal airframes. The new stress analysis theory eliminates conventional ribs and transfers normal shear loads through a stiffened, stressed skin – acting as a torque box – to the spars.

Fig. 1 compares the conventional wing structure with the simplified design of the Seabee. Absence of ribs in the simplified wing is the key to biggest saving of manufacturing costs. Most of the rivets in this wing can easily be installed with automatic riveting machines. Comparison of the two wing designs in Table 1 demonstrates the cost and weight advantage of the new approach.

Table 1 – Comparison of Conventional and Simplified Wings

	Conventional	Simplified
Number of Pieces	114	30
Weight (lb)	150	110
Fabrication (man-hours)	280	15
Number of Rivets	2627	882

External beading of the skin, a strength-adding feature, is formed by steel draw dies on 1000-ton capacity mechanical presses. Shear resistant spars are installed on previously assembled skins by automatic riveting machines which attach both upper and lower spar flanges at the same time. Total assembly time for each spar is about 6 min.

Applying the same principle to other components – tail and control surfaces and hull structures – presents an almost incredible cumulative result of simplification in a complete airplane. Benefits achieved in the Seabee are shown in Table 2.

In embarking on a structural simplification of any airplane, the designer must have an open mind concerning existing theories and practices, judging fairly between what are established scientific facts and what are not. He must build up from the simple, rather than build down from the complex.

Parts should be reduced wherever possible. This will save both production man-hours and often weight. Simplified structures are a boon to final assembly. Egg-box type of construction conventionally used makes for complicated and hard-to-assemble internal interconnecting devices.

Table 2 – Results of Design Simplification in the Republic Seabee

	Conventional Prototype	Simplified Design
Number of Passengers	3	4
Horsepower	175	215
Wing Area (sq ft)	171	196
Gross Weight (lb)	2900	3000
Weight Empty (lb)	2130	1990
Airframe Weight (lb)	1260	1140
Airframe Parts (Number of)	1800	450
Airframe Fabrication Time (man-hours)	2500	200
Airframe Tool Cost at 5000 Airplanes/Year	$1,750,000	$500,000

For years the cry of the aircraft industry has been for large-volume production to offset elaborate tooling costs, making for low-cost structures. The war proved this argument to be unsound. The tremendous wartime effort (and high quantity production) reduced air frame manufacturing costs from $10-$12 per lb to $5-$6 per lb. But this is still a far cry from the amazingly low cost of 20¢ per lb for manufacturing refrigerators and automobiles.

That revolutionary improvements in production techniques will materially narrow this gap is remote. Refinements of design and methods of analysis are the key to sharp reductions in airframe costs. (Paper entitled "Simplified Structures for Low Cost Airplanes," presented at the SAE National Aeronautic Meeting, on Oct. 5, 1946.)

New Car Design Tuned to 1947

Digest of paper

By A. G. LAAS

Studebaker Corp.

STUDEBAKER'S new model, Laas says, is the answer to a five-year time lag with no yearly models, and to the public's growing awareness of aircraft design philosophy. Improvements are extensive because research has continued throughout the carless war period, and because aircraft experimentation has proved and improved many innovations.

Height has been reduced 4 in. over 1942. Rear seat is 11 in. further in front of the rear axle, and wheelbase is 1½ in. longer. Frontal area has been reduced, and the new low silhouette and low c.g. have brought floor height to a new low of 11½ in.

Engine, clutch and transmission all were used on the Weasel. Wartime refinements are evident for instance, replaceable connecting rod bearing inserts of steel-backed, micro-babbitt type. Oil pump capacity has been increased 25%.

Automotive drive transmission has electrical control units. Overdrive cut-in is regulated by the governor, and cuts in at about 30 mph. The necessary overlap to control governor sensitivity provides a cutout speed of about 25 mph. (Paper, "Design Highlights of 1947 Studebaker," presented at SAE Indiana Section, Oct. 10, 1946.)

Wire Strain Gages Relate Shaft Torque

Digest of paper

By A. C. RUGE
Ruge-deForest
J. H. MEIER
Bucyrus-Erie Co.
and C. H. GIBBONS
Baldwin Locomotive Works

RESISTANCE wire strain gages used for measuring static stresses now have been adapted to torque measurement of engine shafts in many cases for which existing instruments are ineffective, report Ruge, Meier, and Gibbons. Describing the device, they point out that:

Strain gages operate on the principle that the physical property of metals – particularly alloys – undergoes a change in resistance to electric current with a change in strain. Since torque produces strain as does any stressed structure, this type of strain-sensitive device measures torque when properly applied to cylindrical bodies such as shafts.

The gages are secured to a length of shaft to which are attached slip rings and a brush holder mounted by means of plain or antifriction bearings. Shaft ends are prepared for flange couplings and the entire unit can be introduced into the torque train at any convenient location.

External calibration of these units requires special devices. Experience has demonstrated that calibration under steady loads is equally valid under conditions of rapidly varying loads. Indicating or recording instruments for use with torque-sensitive pick-ups depend upon the type of data desired.

Mounting the gages on the shaft takes advantage of the fact that a cylindrical shaft subjected to pure torque sustains tensile and compressive stresses (numerically equal to the torque stresses) on two perpendicular lines at an angle of 45 deg to the axis. If we place two gages, as shown in Fig. 1, on the near side of the shaft – insulated from each other – and two gages directly opposite on the far side, name them A, B, C, and D as indicated, then connect them in a conventional Wheatstone bridge circuit, several desirable results will be achieved.

First, any bending in the shaft in any place does not unbalance because strain changes – or resistance – are such that the balance is not disturbed. Second, no direct pull or thrust on the shaft will unbalance the bridge for the same reason.

Third, temperature changes will not unbalance the bridge since all gages change resistance together, provided all gage arms are equally temperature sensitive. And fourth, since the entire bridge is mounted on the shaft, variations in resistance at brush-to-slip-ring contact need not be included in the bridge resistance changes.

Advantages of this device are fourfold: (1) it comes in a small package; (2) its mass, inertia, and centrifugal forces are negligible; (3) it's easy to apply, and (4) steady-state calibrations serve under varying-state conditions. On the debit side of the ledger is the need for slip rings and brushes, adequate temperature compensation, and amplification of electrical output from the stress-sensitive elements mounted on the torque-carrying member.

This device has given good results in a number of applications. In a large aircraft test laboratory it is used on a helicopter-blade test stand. It also has been used on pumps, compressors, engines, fans, ships, airplanes, and tanks. No doubt it can be applied in measuring power take-off on combine harvesters. (Paper entitled "Equipment for Separately Measuring Power in the Cylinder Shaft, Threshing Machinery and Sickle Bar Components of Combine Harvesters," presented at SAE National Tractor Meeting, Milwaukee, on Sept. 11, 1946.)

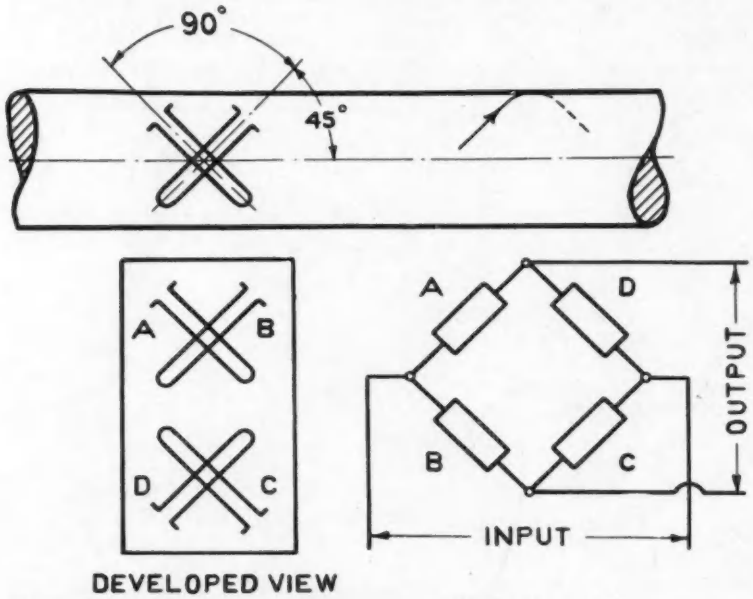


Fig. 1 – How torque-sensitive strain gages are attached to a shaft to form a Wheatstone bridge circuit. Measuring torque with this configuration eliminates disturbances from bending, thrust or pull, temperature variation, and changes in resistance at brush contacts

Three-Cent Airlines Demand Planning Now

Digest of paper

By W. L. FLINN
Capital Airline (PCA)

THREE-CENT per mile airlines are a possibility. If aircraft efficiency is evaluated only in terms of speed, their realization will take a long time. But if prime consideration is given to passenger and cargo handling efficiency, Flinn believes, progress will be much more rapid. The problem calls for decision now . . . decision to plan for flying ground equipment before aircraft fuselage envelope and general contours are frozen in preliminary design.

He proposes, as ground equipment to fly with the airplane:

1. Built-in surface control locks.
2. Built-in auxiliary power source capable of operation with powerplants inoperative.
3. Built-in nose cargoveyor or loading steps, and tail cargoveyor if justified.
4. Built-in tail pedestal.
5. Suitable double safety landing gear locks to eliminate need for auxiliary ground protective installations.
6. Underwing fueling and oiling facilities.
7. Air conditioning facilities capable of operating with powerplants inoperative.

These will add maintenance and basic weight costs. But costs will drop gradually, he is sure, until favorable comparisons can be made with costs of today's adjustable ramp equipment. (Paper "The Case of Flying Ground Equipment," presented at SAE National Air Transport Engineering Meeting, Chicago, Dec. 3, 1946.)

Find Implement HP Through Design Logic

Digest of a paper

By JOHN BORLAND

Clark Equipment Co.

LACK of long-term field experience with self-propelled implements forces the designer to make logical assumptions in calculating average power requirements, declares Borland. Offering a design approach to implement power computations, he shows that:

Implement power needs can be determined by finding the driving torque required to move a machine of given weight over level ground and grades under various soil conditions. Horsepower at any desired ground speed, computed from this torque, is what the axle and transmission must transmit.

Resistance to movement of an implement is the sum of three items – rolling resistance of tires, resistance of the work being done, and grade resistance. (Air resistance is negligible at slow speeds at which implements travel.)

Torque required to overcome total rolling resistance of the machine is the sum of wheel weights, each multiplied by its respective coefficient of rolling resistance. K – the coefficient of rolling resistance varies with road and field conditions and with tire size. Table 1 is a summary of test results with two commonly used implement tire sizes. These data indicate that increasing tire diameter reduces rolling resistance.

Table 1 – Rolling Resistance Coefficient of Implement Tires

Soil Condition	6.00-16 Tire	9-24 Tire
Concrete Road	0.034	0.023
Bluegrass Pasture	0.056	0.053
Loam, plowed and seeded	0.147	0.119
Loam, freshly tilled	0.300	0.186
Loose Sand, freshly tilled	0.286	0.206

The second factor, resistance of work being done, appears to be a function of the width of cut and the type of crop being combined. Although tests have been run on combines doing actual work, total resistance of the machine was determined without segregating cutting resistance. In one of these tests, four different types of wheat were combined with straw length varying from 27 in. to 42 in. Drawbar horsepower was the same in each case.

Since very few farm implements will operate exclusively on level ground, the added power required to haul the machine up grade must be considered. Total drawbar pull required to move an implement up hill is the sum of the pull required to negotiate the grade plus the pull to overcome total rolling resistance. For practical purposes, it is satisfactory to use 10 lb drawbar per 1000 lb weight per 1% grade for determining grade resistance.

Despite approximations used in this method of calculation, results obtained are reasonably close and can be used as a basis for driving machinery design. (Paper entitled "Power Requirements of Self-Propelled Implements," presented at SAE National Tractor Meeting, Sept. 11.)

Economics Favoring Light Alloy Bodies

Digest of a paper

By J. H. DUNN

Aluminum Co. of America

LIGHT-WEIGHT alloys in commercial vehicle bodies are heavy-weights as revenue-producers despite their higher initial costs, Dunn demonstrates. Arguing the case for aluminum and magnesium in highway transportation, he shows that:

To haulers whose vehicles are limited in weight by legal restrictions, each pound of weight saved is worth $1 per year. Truck-tank operators can anticipate freedom from scalling and 10% greater gallonage by using aluminum. Operators seldom loaded to legal limits can expect better gas and tire mileage; faster acceleration and deceleration; better hill climbing; better maneuverability in traffic; faster schedules, and reduced license fees.

Here's what some of these advantages mean in actual figures, assuming a light truck of 5300 lb gross vehicle weight in which 500 lb is saved in the body:

Gasoline consumption will vary almost directly with the weight involved. About a 10% increase in gasoline mileage can be expected. At 10 mpg and 20,000 miles per year, it will add up to some $40 saved.

Tire mileage is said to increase 25% with a 10% decrease in load. About $25 worth of tires should be saved on a 30,000-mile expectancy. Improved acceleration and gradeability are more intangible results. Since acceleration is directly proportional to weight, acceleration should be bettered by 10%.

Economies show up even better where saving in weight permits smaller chassis. In such cases, the lower chassis cost can offset increased cost of lighter bodies; then all savings in operating costs are so much gravy to the operator. The above advantages become more pronounced with lighter chassis.

Structurally light alloys have one distinct advantage – their low specific gravities permit use of huskier sections. For example, if aluminum is increased 40% in thickness over steel, it will still weigh only half as much. This is important because use of high properties of alloy steels have, in several cases, reduced thicknesses to the point of failure by local buckling.

Determining comparative costs is difficult because of the many variables involved – particularly fabrication. But a fair figure in comparing aluminum and steel is that aluminum will save one-half the weight of parts substituted for and will cost about 25¢ per lb of weight saved. If using aluminum decreases the body weight 500 lb, extra cost of material will be $125.

As far as the price of magnesium is concerned, shapes will cost about as much as aluminum – piece for piece. While the price per pound is higher, you do not buy so many pounds.

Another factor that helps to offset the higher initial price of these alloys is their scrap value. When an aluminum body completes its useful service, it will command a reasonably good scrap price compared to steel. (Paper entitled "Aluminum and Magnesium in Highway Transportation Bodies," presented at SAE National Transportation & Maintenance Meeting, on Oct. 17, 1946.)

JATO on Airliners Eases CAA Rules

Digest of a paper

By E. E. NELSON

Aerojet Engineering Corp.

ADDED power when the airplane needs it most for safety and performance is readily provided by JATO (jet assisted take-off), declares Nelson. He shows that:

JATO can be of vital help in scheduled airline flights for compliance with CAA T-category regulations.

Additional power available with JATO will shorten take-off time and distance. It also will increase one-engine-inoperative rate-of-climb, reducing time and distance required to clear the 50-ft obstacle. A 73,000-lb. DC-4 requires about 4500 ft at sea level on a standard day. Adding four JATO's at 80 mph reduces this distance to 3200 ft.

In the first segment of take-off climb (time required to retract the landing gear), one JATO motor providing 1000 lb. of thrust will enable this same DC-4 to meet the 50-fpm rate-of-climb requirement up to a 9000-ft altitude.

In the second segment of take-off climb (time required to retract the flaps and feather the inoperative en-

gine), 1000 lb of JATO thrust will make the DC-4's 3-engine rate-of-climb equal 0.035 Vs_1^2, as required by CAA, up to a 7200-ft altitude. Although an accurate analysis has not yet been made, it appears that JATO can provide the thrust needed to meet CAA requirements for the "approach climb" and "landing climb" configurations.

JATO has many other advantages. Additional power is available to the pilot in convenient increments – 1000 lb of thrust in 12 sec – at the flick of a switch. It can be attached to an airplane in a minute or two. There are no maintenance or service problems and no special training of ground crews and pilots is required. (Paper entitled "Application of Jet Assistance to Transport Aircraft," was presented at the SAE National Air Transport Engineering Meeting, December 3, 1946.)

Adequate Crankcase Ventilation Needed

Digest of paper

By H. L. MOIR and H. L. HEMMINGWAY

Pure Oil Co.

CRANKCASE ventilation – why it is necessary, how it can be accomplished – is the subject of an article to appear shortly in SAE Quarterly Transactions.

The article will point out that, although the value of adequate crankcase ventilation has been recognized for 20 years, engines are still being built with no provision for ventilation or with a system that is inadequate under certain conditions of operation.

As a result, the authors will say, it has been necessary for the users of some engines to devise ventilating gadgets of their own.

This fact was discovered through a questionnaire that the authors circulated to determine which types of ventilation are actually being used and how successful they are. The replies were particularly valuable, for in many cases the operators not only told their experiences with the methods described in a service bulletin of the authors' company but even included some methods they themselves had devised.

The article contains descriptions and illustrations of many methods, including some of those reported in the replies to the questionnaire. Advantages and disadvantages of each method are discussed, so that one can determine quickly which method will work best for a particular application. (Paper, "Effect of Crankcase Ventilation on Engine Deposits," presented at SAE Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1946.)

Brake Philosophy Means Better Use

Digest of paper

By STEPHEN JOHNSON, JR.

Bendix-Westinghouse Automotive Air Brake Co.

BRAKES probably are the hardest used and least pampered parts of automotive vehicles, Johnson believes. He points out that:

Modern truck or bus brakes are about 10 times as powerful as engines, being required to stop vehicles about that much faster than acceleration is accomplished. At the same time, energy of motion and heat energy generated at the brake drums increase as the square of the increase in average speed.

Engine is supplied with cooling system and fan to keep operating temperature low, and water circulates through the cylinder block and head. Brakes, in contrast, are mounted under streamlined fenders where dirt and water reach better than air. Engine lubrication is efficient, but brakes usually are not lubricated properly on sliding contacts, have too much oil or grease on lining surfaces and other parts where it doesn't belong.

Altogether, it is a wonder that brakes perform as well as they do. Most important step in brake development, Johnson feels, is the establishment of fundamental principles. Ingenious devices in recent years have improved performance, but more useful has been the increased appreciation and use of potentialities of power brake apparatus to increase convenience, economy and safety of transportation. (Paper "Braking of Heavy-Duty Vehicles," presented at SAE Pittsburgh Section, Oct. 22, 1946.)

Flying Hazards Reduced By Simplified Controls

Digest of paper

By G. W. NEWTON and W. K. KLOSE

Boeing Aircraft Co.

INCREASED complication of aircraft controls has made the pilot's job intricate, has multiplied possible hazards. Complexity has been the natural outgrowth of increased power and improved performance, but progress has unfortunately been too rapid to permit complete redesigning of control units.

Efforts toward simplification have been fairly successful with oil cooler flaps, engine speed, exhaust driven supercharger, and F/A ratio. But this is only a beginning. The authors suggest, as a rational approach to the control problem, that the system begin with a single "go" lever with separate controls added when they perform a definite service to the pilot. Interrelationships and sequence operations would be eliminated.

In addition to the single lever per engine, the plane would have a series of on-off switches, possibly including a start switch; a cruising switch to provide more economical cruising mixture setting; a carburetor heat switch, and a cabin supercharging switch. Other functions could be added in switch form as needed, but should be kept to a minimum, and eliminated where further automatic controls permit.

For further simplification, they suggest:

- Keeping ground-check-out panel covered or out of the way in flight,
- Substituting red and green lights for a continual pilot checking of instruments, keeping check instruments out of sight. (Paper, "The Future Of Automatic Power Controls," presented at SAE National Aeronautic Meeting, Los Angeles, Oct. 3, 1946.)

One-Cylinder Engine Runs Gamut of Uses

Digest of a paper

By LEO LECHTENBERG

Briggs & Stratton Corp.

VARIED applications in sundry fields have been found for the single-cylinder aircooled gasoline engine, says Lechtenberg. He points out that:

Developing from 2/3 to 6½ bhp, these "midget" powerplants are useful on farms, railroads, and in industry.

The farmer uses them to power water systems to provide running water for live stock. They drive garden tractors, cultivators, sprayers, planters, elevators, hay jacks, wood saws, and dusters. In the barn they run milking machines, coolers, separators, grinding mills, root cutters, and tool grinders. Small generator sets furnish power for electric lights and radio on many farms. They also can be used to charge truck, tractor, and automobile batteries.

On the railroads these engines operate utility cars, rail saws, grinders, spike drivers and pullers, and bolt tighteners. They power compressors on refrigeration trucks and thousands of lawn mowers. Industry finds them useful as engines in material-moving trucks.

These same engines have been put to work in the construction business to drive water pumps, cement finishers, line markers, compressors, and a dozen other pieces of equipment.

Chief reason for the misapplication of small engines is that users expect a 1-hp gasoline engine to perform just

like a 1-hp electric motor. The electric motor can deliver large overloads for short periods. Although rated at 1 hp, an electric motor will pull 1½ hp if the demand arises.

But this isn't the case with a gasoline engine. If it is rated at 1 hp, it will never produce 1½ hp. For this reason it is recommended that customers never design for more than 85% of maximum brake horsepower. (Paper entitled "Small Aircooled Gasoline Engines," presented at SAE Milwaukee Section, on Nov. 1, 1946.)

German Survey Yields Almost No Comparison

Digest of paper

By AUSTIN M. WOLF
Automotive Consultant

GERMAN automotive practice is rich in originality, poor in standardization... does not surpass our own. Summarizing conclusions drawn from his study of German passenger car and truck chassis as a participant in the TIIC investigation in 1945, Wolf reported that:

1. Engineering development has been practically negligible during and since the war; so few cars were produced that there was no serious material shortage; and truck producers were government-confined to a single model, so that engineering and design were stunted.

2. There are no trade and engineering organizations such as those in the United States to develop vehicle ratings. Consequently standardization is on a comparatively primitive level. American gvw system is not used, but the rating covers actual load to be placed in the body. Ratings are conservative to begin with, since distributors and dealers both are likely to up them when the vehicle has left the factory.

Wolf's exhaustive survey of all truck and passenger car parts discloses actually only one area of German production at which it would pay American designers and producers to look:

Small production gave German designers a unique opportunity to approach problems with a view to delivering superior performance characteristics without too much attention to costs. American mass production, on the other hand, often will sacrifice some efficient design feature or accessory to keep cost down if overall operating economics warrant it. He feels it might be worthwhile, on the basis of this comparison, to "recheck our balance of values." (Paper, "Observations on Automotive Equipment in Germany," presented at SAE National T&M Meeting, Chicago, Nov. 11, 1946.)

Volatile Fuel Needed For Arctic Operation

Digest of paper

By WILLIAM L. HULL
University of Colorado
and NORMAN A. PARKER
University of Illinois

AN article to be published shortly in SAE Quarterly Transactions will discuss the effect of fuel volatility on the performance and fuel distribution of aviation engines.

Tests were made with an Allison V-1710-111 engine and a Continental A-75 4-cyl opposed aircraft engine operating down to —40 F carburetor air temperature.

Briefly, the authors reached the following conclusions:

1. Break temperature (the temperature below which fuel flow must be increased to maintain engine rpm and manifold pressure) is a function of fuel volatility and the per cent of rated power being delivered by the engine: the more volatile the fuel or the higher the power, the lower the break temperature will be.

2. The error in fuel-air mixture distribution is a function of fuel volatility, power being delivered by the engine, and carburetor air temperature: the error increases as volatility, power, or carburetor air temperature decreases.

3. Neither of the customary fuel antiknock additives, tetraethyl lead or ethylene dibromide, necessarily follows the gasoline into the cylinder – thus accounting for the varying lead deposits in cylinders and the differences in the detonation intensity in the various cylinders.

(Paper "Fuel Volatility – Its Effect on Performance and Distribution," presented at the SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 8, 1946.)

Points to Pump for Better Fuel System

Digest of Paper

By WILLIAM J. BURNS
Carter Carburetor Corp.

CONSIDERABLE glamor has been focused upon postwar products, Burns pointed out, but in actual practice changes to date do not warrant this attention. Referring to the possibility of injection, he intimated that the cost of the plain tube carburetor could be expected to preclude the immediate use of injection systems. Improvement in fuel consumption is accomplished, but with some sacrifice in performance, as before.

Application of dual carburetors in truck engines is increasing, but it was also noted that one eight cylinder engine originally designed for dual carburetion operated more effectively with a single barrel unit. This controversial condition will continue to be an issue.

Fluid transmissions require special devices which have been subjected to considerable study made necessary by the complications of throttle closure during operation of these units.

Possibility of increasing economy, particularly for fleet operation, can be developed by using a production engine with a smaller manifold and carburetor.

New performance with mechanical fuel pump was credited to:

1. A one-piece diaphragm with the engine side protected from attack by crankcase oil and temperature;
2. Increased volume made possible by an increase in valve capacity;
3. A new finish to discourage the decomposition of the alloy castings;
4. A delivery pressure of 5 psi with pulsation damped out by the use of an outlet diaphragm of resilient material;
5. A simplified linkage using a C-channel arm of unusual strength.

The efficiency of any mechanical pump has been limited by the possibility of vapor lock induced by heat due to most locations and low temperature hazards in others. (Paper "Postwar Fuel Systems" presented at SAE New England Section, Dec. 3, 1946, and Canadian Section, Jan. 16, 1947.)

European Geography Snarls Plane Service

Digest of paper

By K. H. LARSSON
Swedish Airlines

AIRLINES radiating route patterns pose maintenance problems for European operators not encountered with the chain type route found in this country, says Larsson. He points out that:

Prevalence of the "hub" pattern stems from the fact that Europe consists of many countries, each with its own national airline, and each airline wanting to operate in the other territories. A radiating route pattern with terminals in foreign countries complicates maintenance.

To overcome these problems, line maintenance often is pooled between European operators; but each company usually keeps some key personnel and spare parts of its own at each place.

Keeping ground personnel for extended periods in foreign countries – and often isolated places – is a problem in itself. Such employees must speak

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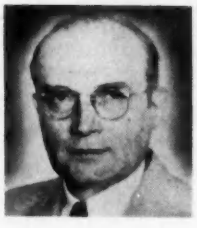
About SAE

C. C. (CHET) PEARSON has been appointed general manager of the Airplane Division, Curtiss-Wright Corp., with headquarters at Columbus, Ohio. Wartime manager of the Douglas Aircraft Co., Inc., Oklahoma City plant, he had been with that company for 16 years. He was educated at Whittier College, Whittier, Calif.

ELBERT E. HUSTED, president of Titeflex, Inc., of Newark, N. J., manufacturers of pressure tight all-metal hose, has announced that they have completed their reorganization program. The former management is directing all activities, and will also specialize in radio shielding, and flexible and solid radar connections. Mr. Husted has long been active in the Society, and served as chairman of the Metropolitan Section.



EDWIN R. SMITH, following many years as treasurer and general manager of Seneca Falls Machine Co., Seneca Falls, N. Y., has been elected president of the company. He served as SAE vice-president for Production Engineering, and was a member of the SAE Production Division.

TIMOTHY E. COLVIN has been elected executive vice-president and director of Besler Corp., Emeryville, Calif. He was formerly president of Aerco Corp. in Los Angeles. Mr. Colvin has bought an interest in the corporation, and is part of a plan to expand its manufacturing and sales activities.

JAMES H. MARKS, until recently executive vice-president of Packard Motor Car Co., has resigned after 30 years with the automobile manufacturer to become consultant for Dearborn Motors Co. He will coordinate procurement and engineering of farm implements for the newly organized firm, successor to Harry Ferguson, Inc.

ROBERT M. BERNS is now engineer and designer for Vought Co., Beverly Hills, Calif., manufacturers of aircraft cameras.

Formerly sales engineer for Alma Motor, Detroit, **CECIL C. BUCKNER** is now chief engineer of Detroit Industrial Engineering Co.

Having left Shaffer Tool Works, Motor Division, Brea, Calif., **RUDOLF MANGOLD** is now chief engineer of Diesel Power, Inc., same city.

Previously owner of the LaFrentz Bros. Service, Burbank, Calif., **FRED H. LaFRENTZ** has become president of LaFrentz Liquid Gas Co., Cedar City, Utah.

Now president of Dedo Products, Inc., Birmingham, Mich., **HOMER H. DEDO** was research director for Ethyl Corp.

J. H. SCHROEDER is president of the Fox River Mfg. Co., Oshkosh, Wis., manufacturers of machine tools and special machinery.

Resigning from Guiberson Diesel Engine Co., **ELI SHAPIRO** became assistant chief engineer of the Dearborn heater Co., Dallas, Tex.

JOHN SHEPPARD CUMMING is executive assistant to the general manager of Aer Rianta Teoranta (Irish Airways), County Dublin, Eire, Ireland.

Before joining McCulloch Aviation Co., Los Angeles, as design engineer, **WILLIAM A. JOHNSON, Jr.** was with Lockheed Aircraft Corp.

Formerly product engineer for Timken-Detroit Axle Co., Detroit, **AXEL JANSSON** is now designer and checker for Continental Aviation Engineering Corp., Detroit.

JOSEPH KIM, who was previously with Bendix Aviation Corp., is now a free lance consultant, South Bend, Ind.

MANFERD BURLEIGH, president of Great Lakes Greyhound Lines, Inc., Detroit, since 1932, recently became president of American Buslines, Inc., Chicago.

Former designer and draftsman at Born Engineering Co., Tulsa, **VERNON E. MUSSER** is now affiliated with Seiberling Rubber Co., Akron.

DONALD L. NOWELL has returned to civilian status with the Bureau of Aeronautics, Washington, D. C. He is continuing the work on quality control of aviation fuels and lubricants which he did while serving as lieutenant commander in the U. S. Naval Reserve.

Previously connected with Bendix Aviation, **A. P. FONTAINE** is now director of the Research Center, University of Michigan at Willow Run Airport.

Announcement has been made of the appointment of **JOHN B. DUCKWORTH** as assistant director of research at Standard Oil Co., Indiana. He has been a member of the research department since 1936, except for four years with the Air Technical Service Command at Wright Field, Dayton, Ohio.

STEVE A. SCHNEIDER is now associated with Creole Petroleum Corp., Maracaibo, Venezuela. Prior to taking this position, he was foreman at Cleveland Diesel Engine Division, General Motors Corp., Cleveland.

The Detroit Sales Executive Club recently announced the election of **C. M. PETER,** of Fellows Gear Shaper Co., as president for the coming year.

Members

MILTON K. McLEOD, who became manager of the Coordinating Research Council on Feb. 1

C. B. VEAL, who has resigned as secretary and manager of CRC to enter consulting work

"Tips on Spring Service and Inspection," published by the Leaf Spring Institute, is a 28-page pocket-size booklet written recently by **MURRAY FAHNESTOCK,** an active SAE member who has served on numerous administrative and technical committees and was a Councilor. It is illustrated, and is based upon practical experience of both fleet operators and suspension engineers. Copies are available from the Institute, 315 Boulevard Building, Detroit 2.

RALPH HULTON is now representing Rodic Rubber Corp. of Garwood, N. J., in sales and engineering for the state of Michigan and the city of Toledo. The Rodic Corp. manufactures molded and extruded rubber parts.

Recently named development engineer at Dewey Almy Chemical Co., Weymouth, Mass., **ROBERT R. WOODCOCK** was formerly mechanical engineer at General Electric Co., Bridgeport, Conn.

Connected previously with the U. S. Army Detroit Arsenal, Center Line, Mich., **WILLIAM L. DRENNEN** is now a major in the U. S. Army Ordnance Department, stationed in Rome, Italy.

C. B. VEAL, manager of the Coordinating Research Council, Inc., since its organization more than five years ago, has resigned to enter consulting engineering practice, according to **JAMES M. CRAWFORD,** president of the organization. **MILTON K. McLEOD,** who was named assistant to Mr. Veal about a year ago, was appointed manager. The CRC board also elected Miss Genevieve Walmsley secretary of CRC.

An SAE member since 1912, Mr. Veal served for 17 years as the Society's research manager and also served as secretary of the Cooperative Fuels Research Committee up to the time he joined the newly organized CRC.

A graduate of Purdue University in 1902, he taught machine design, administered a course in car and truck design and engine testing, and was appointed professor of that subject at Purdue in 1911. Later he did consulting work for a number of companies, and at one time was associated with the late Charles Manly as consulting engineer.

A frequent contributor to technical literature, Mr. Veal has had a number of his papers published in the SAE Transactions and the SAE Journal. He was awarded the 1945 Horning Memorial Lecture Award for his "Philosophy of Cooperative Research," presented at the SAE 1946 Annual Meeting.

For his contributions to the war effort Mr. Veal was personally honored with the Naval Ordnance Development Award and the Army Meritorious Certificate, as well as the ASA certificate of meritorious service for his part in the war emergency.

Mr. McLeod graduated from M.I.T. in 1935, and completed his graduate work for his master's degree two years later while serving there as an instructor. For three years he taught at Beloit College evening school while a research engineer with Waukesha Motor Co.

Commissioned in the Army Air Forces, he was assigned to duty as research engineer on aviation fuels and lubricants. In that connection he represented the Air Technical Service Command on several CRC committees, and joined the CRC staff soon after he reverted to inactive service having been advanced to the rank of major.

WARREN A. TAUSSIG has been promoted to vice-president of Burlington Truck Lines, Inc., with headquarters in Galesburg, Ill. A former vice-president of the Society for Transportation & Maintenance, he has been active on numerous SAE technical and administrative committees.

Announcement has been made of the promotion of **ARTHUR E. GIBBS** as assistant sales manager in charge of the Chicago sales district and **CHARLES L. SMYTHE** as assistant sales manager in charge of the Cleveland, Ohio, and Western Pennsylvania sales districts, of the Cleveland Graphite Bronze Co., Cleveland.

WILLIAM J. BIRD has been appointed a vice-president of the Fargo Division, the fleet sales organization of Chrysler Corp. Prior to this promotion he had been divisional operating manager of Fargo.

T. R. DINSMORE recently became affiliated with the Frigidaire Division of General Motors Corp., Dayton, Ohio.

Assistant general manager of Inland Truck & Diesel Co., Spokane, **ORVILLE P. MARTIN** was formerly parts and service manager at the Tame Co.

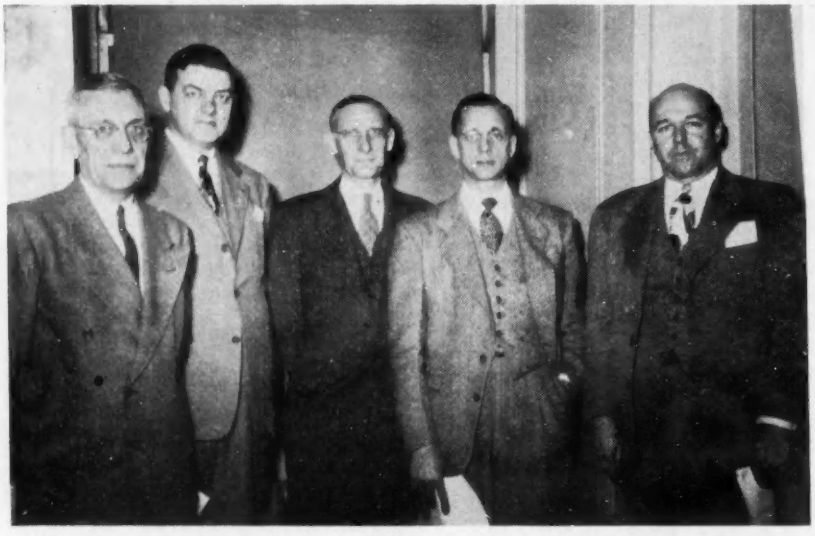
Preceding his appointment as vice-president and general manager of Columbia Transfer Co., Kansas City, Mo., **FOSTER R. GAYLORD** was general manager at Columbia Terminals Co., Inc., Cincinnati.

ALPHONSE F. SIERS formerly with ACF-Brill Motors Co., and Pesco Products Co., is now with the General American Aerocoach Co. as special assistant to vice-president in charge of engineering.

H. MAYNARD SNOW transferred from Cab Service & Parts Corp., New York City, to Checker Cab Mfg. Corp., Kalamazoo.

Promoted to assistant to the president at Timken-Detroit Axle Co., **FRED W. PARKER** was director of service.

STANDARD BRANDS FLEET MANAGERS



Managers of Standard Brands, Inc., fleets have been announced by HARRY O. MATHEWS, (second from left) the company's manager of fleet operations. They are, left to right, EARL M. BIEHL, in charge of special body and equipment design for the company; Mr. Mathews, a former vice-president of the Society; JOHN W. LIMPERT, assistant manager, eastern, including New England, Pennsylvania, Virginia, Maryland, Delaware, New York, and New Jersey; NELS F. LENNHOLM, assistant manager, midwest, including the rest of the states east of the Mississippi River and Louisiana and Arkansas; and ALFRED E. TENNANT, assistant manager, western, which embraces the remainder of the U. S.

A. E. ULMANN has been appointed vice-president of Frank Ambrose Aviation Co., Flushing, L. I., N. Y. Prior to this he had been president of Hub Industries, Inc., Long Island City, N. Y.

Previously connected with Sav-Way Industries, Center Line, Mich., as chief engineer, **CHARLES S. WHITE** has been appointed president of Perma-Steel Metal Products Inc., Detroit.

After serving in the U. S. Navy, **NELSON J. KREIDER** has been appointed chief engineer at Dexter Machine Products, Inc., Chelsea, Mich.

LEWIS K. DALRYMPLE who had been chief engineer of the Mid-Continent Division, Tide Water Associated Oil Co., Tulsa, has announced his retirement from business.

Prior to becoming assistant to the vice-president and director of laboratories at California Research Corp., Richmond, **LLOYD H. MULIT** was assistant to director for the same company in San Francisco.

Formerly senior engineer, Turbo Division, B-W Superchargers Division, Borg-Warner Corp., Cleveland, **CHARLES B. BRULL** is now director of production for Turbomeca, in Basses-Pyrenees, France.

JAMES EDWARD STOCKTON, assistant superintendent at the Prest-O-Lite Co., Inc., Detroit, has been transferred to Hammond, Ind.

A former lieutenant in the U. S. Navy, **RALPH H. LEBOW** is now development engineer at the Universal Winding Co., Cranston, R. I.

Formerly assistant chief test engineer, Sterling Engine Co., Buffalo, **ALSON J. COVEL** is now sales and service representative at the Battery & Starter Co. of that city.

Resigning as truck engineer from Mack Mfg. Corp., Allentown, Pa., **ALBERT A. PREVOST** is now consulting engineer with Lindholm Associates, New York City.

WALTER G. HILDORF, director of metallurgy, Timken-Roller Bearing Co. has been transferred from Canton, Ohio, to Los Angeles.

An automotive consultant, **WALDO GEORGE GERNANT,** 616 N. River St., Ypsilanti, Mich. was formerly chassis engineer at Graham-Paige Motors Corp., Detroit.

Formerly associated with Bendix Aviation Corp., Teterboro, New Jersey, **MILLARD F. PERRY** is now with Essex County Vocational School, Newark.

Prior to his appointment to general manager, **GORDON E. SMITH,** Soo Freight Lines, Ltd., Universal Storage Co., Regina, Saskatchewan, Canada, was manager, Petroleum Department, Saskatchewan Federated Co-Operatives, Ltd., in that city.

Previously with Lima Locomotive Works, Inc., Lima, Ohio, **SCOTT B. BARNHARDT** is now employed at Westinghouse Electric Corp., in the same city.

COL. C. L. CHRISTENSEN is now partner and manager of Highmount Ski Center, Highmount, N. Y.

Formerly chief engineer of Wentworth & Irwin, Portland, Ore., **DICK F. WAGNER** is now engineer and plant superintendent at Commercial Truck Body & Allied Parts in the same city.

BERNHARDT J. LITKE, former flight engineer instructor with the U. S. Army Air Forces, is now associated with Lockheed Air Terminal, Burbank, California.

Previously in the U. S. Merchant Marine, **ROBERT E. WILLISON** is now product engineer with Thompson Products, Inc., Euclid, Ohio.

WALTER I. RODGERS, JR., recently appointed cost analysis engineer at ACF-Brill Motors Co., Philadelphia, was formerly assistant to the chief engineer at Mack Mfg. Corp., New York City.

LEONARD GUSTAV SCHNEIDER, formerly a major in the U. S. Army,

Coast Artillery Corps, is now with the U. S. Naval Engineering Experiment Station, Annapolis, as diesel engineer.

Until recently engineer at Chinese Petroleum Corp., Shanghai, **WEN CHICH-NGE** is now an observer at International Derrick & Equipment Co., Marietta, Ohio.

Prior to becoming chemical consultant, **MANUEL H. GORIN** of 1850 Ortega St., San Francisco, was associated with Magnolia Petroleum Co., Dallas.

J. ARNOLD JONES recently became general manager of petroleum sales at Everybody's Oil Corp., Anderson, Ind.

Until recently an analyst with OPA, **WILLIAM A. McCUTCHEON** has been appointed administrative analyst with the U. S. Bureau of the Budget, Washington, D. C.

JOHN V. CURTIS was recently appointed foundry engineer at John Inglis Co., Ltd., Production Castings Division, New Toronto, Ontario. He had been project engineer at Turbo Research, Ltd., Leaside, Ont., Canada.

Previously affiliated with Empire Electric Brake Co., Newark, as design engineer, **FRANK D. WARNER, JR.** has been appointed production manager at Chadwick, Inc., Darby, Penna.

Resigning from Baldwin Locomotive Works, Philadelphia, **ANKER K. ANTONSEN** is now connected with Fairbanks Morse & Co., Beloit, Wis.

Having been discharged as lieutenant from the U. S. Army Air Forces, **ROBERT E. KLEIN** has become production assistant at Kaiser, Inc., Fontana, Calif.

Leaving the Packard Motor Car Co., Toledo, **WILLIAM HOWARD McCOY** is now with McCoy Engineering Sales Co. in Detroit.

After attending Stamford University in California, **LOREN C. SACKETT** is now research engineer with North American Aviation, Los Angeles.

ROBERT L. BENNETT has recently been appointed staff assistant for motor vehicles at the Southern California Telephone Co. in Los Angeles.

Resigning recently as district sales manager from Willard Storage Battery Co., Dallas, **RAY C. ROLPH** is now associated with Southwest Wheel Inc., Dallas, as manufacturers representative.

HUDSON T. MORTON has been appointed general manager of Chelsea Heat Treating Co., Chelsea, Mich. Prior to this appointment he was associated with Fafnir Bearing Co., New Britain, Conn.

Until recently chief engineer at Tamelo, Glendale, Calif., **WILLIAM C. McFADDEN** has been appointed director of planning and engineering at Pacific Airmotive Corp., Burbank.

VICE-PRESIDENT OF McDONNELL

DON R. BERLIN was recently elected a vice-president of McDonnell Aircraft Corp., St. Louis, by the board of directors. He will serve as general vice-president in charge of aircraft contracts and engineering, the company announced. A veteran aeronautical engineer, he designed the Curtiss P-40 pursuit fighter, while he was with Curtiss-Wright Corp.'s Airplane Division. He later transferred to General Motors Corp. as an aeronautical engineer.

Chief Engineer **LELAND S. PRIOR, JR.**, of Motors Inc., Mexico City, D. F., previously was aviation engineer at Union Oil Co. of Calif. in San Francisco.

Formerly director of finance, Citizens Public Expenditure Survey of N. Y. State, Albany, **LAWRENCE B. WHIT** has been appointed associate director of the Research Council on Problems of Alcohol, in New York City.

LEO A. BIXBY (as announced in the February issue), has been appointed manager of engineering of Clark Equipment Co., Buchanan, Mich. All engineering developments of the company's divisions will be headed by Mr. Bixby, the company announced.

HARRY E. KARST has been appointed director of research for Western Air Lines with headquarters at the airline's general offices in Beverly Hills. He had been superintendent of mail, express, and cargo, and has been in the air transport field for the past 15 years.

JAMES J. WELKER recently became general manager of Willys-Overland Motors, Inc., West Coast Division, Los Angeles. Previously he had been assistant resident engineer, Fisher Body Division, General Motors Corp., Pontiac, Mich.

MAX M. ROENSCH has joined the Ethyl Corp. engineering department of the research laboratories in Detroit. He will be responsible for research and development pertaining to the power, economy and durability of engines. He had recently been chief engineer of the Cleveland Graphite Bronze Co.

Having resigned from the National Advisory Committee for Aeronautics, where he was a mechanical engineer, **EARL L. SHERMAN** is now development and test engineer at Menasco Mfg. Co., Burbank, Calif.

Having been discharged as lieutenant from the U. S. Army Air Forces, **ROBERT O. KINSEY** is now affiliated with the Civil Aeronautics Board, Washington, D. C., as a liaison officer.

CLIFFORD CARR is affiliated with David Brown Tractors, Ltd., Huddersfield-Yorks, England, as assistant service manager.

EARL G. BENNETT has joined E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Previously project engineer with Airesearch Mfg. Co. of Arizona, Inc., **STUART H. HAHN** is now checker and design engineer for Wilmix Engineering, Santa Clara, Calif.

CHARLES R. EVANS who was district manager for E. W. Saybolt & Co., Ponca City, Okla., is now refinery sales engineer for the Oil Well Supply Co., Dallas, Tex.

Prior to joining E. I. du Pont de Nemours & Co., Wilmington, Del., **M. H. CAMPBELL** was research engineer for Standard Oil Co. of Ohio, Cleveland.

WILLIAM W. CARTER is now director of Standard Safety Service, Kansas City, Mo. He was formerly connected with the Bureau of Motor Carriers, Interstate Commerce Commission.

Until recently, when he became chemist of the Products Application Department of Shell Oil Co., Inc., New York City, **CYRIL HENRY BARTON** was with the Asiatic Petroleum Co., Ltd., London, England.

One of the 43 individual Charles A. Coffin Awards announced by the General Electric Co. was presented by S. E. Gates, Manager, Los Angeles Office, to WAYNE H. ALLEN, (left), aviation engineer at the same office. This award, one of the highest made by the company, is presented to employees who have made contributions towards the increase of the company's efficiency or progress in electrical art.

Until recently regional chief, Automotive Division, U. S. Bureau of Surplus Property, **WILLIAM J. MILLER** is president and general manager of Washington Truckstell Sales, Inc. Toastmaster for the 1946 West Coast T & M Meeting, he has been associated with automotive engineering for years. In 1912, he collaborated in preparing the electric vehicle section of Kent's Handbook.

WILLIAM W. DUNNELL, JR., of the engineering staff of the Division of Industrial Cooperation, M.I.T., was awarded the U. S. Navy's Certificate for Exceptional Service to Naval Ordnance Development. He had been chief engineer of Rivett Lathe & Grinder, Inc., Boston, but resigned to accept reappointment to work with **PROF. CHARLES S. DRAPER** at M.I.T.

NORMAN VIVIAN, formerly assistant to the general manager of Ontario Automobile Co., Ltd., is now president of Huddleston Motors Ltd., Toronto.

FRED H. SQUIRES has become general sales manager for Universal Boat & Carrier Co., Pasadena, Calif.

CHARLES W. FRANCE is now serving Eastern Air Lines, Inc., Miami, Fla., in the capacity of vice-president in charge of maintenance and engineering.

THOMAS B. MARTIN is now chief engineer for Burden Co., Hollywood, Calif.

A technical service engineer at Intava, Inc., New York City, **NORMAN H. BRUBAKER** was formerly associated with Standard Oil Development Co., Elizabeth, N. J.

Returning from naval service recently, **DAVID W. WHITTLESEY** is an aeronautical engineer, Army Air Forces, Air Materiel Command, Wright Field, Dayton.

HARRY J. GRAHAM, project engineer, has transferred from Wright Aeronautical Corp, Wood-Ridge, to Menasco Mfg. Co., Burbank.

Formerly trade commissioner, Government of Travancore, South India, **EDWARD G. SALTER** is manager Public Utility Transport Corp., Ltd., Johannesburg, South Africa.

C. H. KITCHELL has transferred from Taylorcraft Aviation Corp., Alliance, Ohio, to Bellanca Aircraft Corp., New Castle, Del.

Prior to becoming sales engineer, Wright Aeronautical Corp., Wood-Ridge, N. J., **GORDON V. CHRISTY** was associated with Wright Aeronautical, Ltd., Los Angeles.

MAJOR RONALD MOGFORD is director of aircraft maintenance, Haneda, Tokyo. Prior to this assignment he was stationed at Bolling Field, Washington, D. C.

NELSON E. FARLEY, JR., has recently been promoted from research engineer to chief experimental engineer at Kaiser-Frazer Corp., Willow Run.

T. A. O'CONNOR is owner-manager of T. A. "Tom" O'Connor, Fullerton, Calif. Prior to this, he had been assistant to vice-president, Studebaker Pacific Corp., Los Angeles.

A power plant group engineer,

K. W. WARREN has been promoted to sales manager of Federal-Mogul Corp., Detroit. Formerly he had been assistant sales manager. He graduated in mechanical engineering at Stevens Institute of Technology.

HAROLD HEATH after a long and active career in the British automotive industry has resigned his directorships of Humber, Ltd., and associated companies. He plans to take an extensive vacation before returning to the industry, and intends making a trip to America to inspect developments in automotive engineering.

LOUIS MANNING, has transferred from Goodyear Aircraft Corp., Akron, to Boeing Airplane Co., Wichita.

CAPT. HECTOR ALEXANDER has been named chief pilot and engineer of Frank Ambrose Aviation Co., Flushing, N. Y.

Until recently with Eclipse Pioneer Division, Bendix Aviation Corp., **HARRY JOSEPH** is a senior cost estimator with Ranger Aircraft Engines, Farmingdale, L. I., N. Y.

THOMAS D. REEDY has joined Wire Assemblies Corp., Detroit, as sales manager. He had been sales representative with Essex Wire Corp.

Formerly with Trans World Airways as assistant operations manager for France, **FRANK P. WEST** has been appointed superintendent of traffic, International Division, Linea Aeropostal, Venezolana, Caracas.

Resigning from Pointer-Willamette Co., Portland, Ore., as production manager, **TOM STIGUM** has joined Remolques Eumex, Mexico, D. F.

VICTOR A. PARKER has organized a radiator service business under his name at Yakima, Wash., since resigning as supervisor of the Mt. Rainier Ordnance Depot, Tacoma.

Until recently with Boeing Aircraft Co., **JOSEPH G. MALONEY** is now a powerplant engineer with Consolidated Vultee Aircraft Corp., San Diego, Calif.

ALAN E. PARK has joined the Perma-Mold Castings Co., Moline, Ill., as mechanical engineer. He had been with the Cleveland laboratory of the NACA.

MISS LIDIA MANSON, now affiliated with Fredric Flader, Inc., North Tonawanda, N. Y., was research engineer at DeLaval Steam Turbine Co., Trenton, N. J.

JOHN HINCHMAN has joined Graydon Smith & Co., Boston.

Engineering design supervisor on heating and ventilating equipment, at North American Aviation, Los Angeles, **DONALD D. WALLER** was formerly design staff engineer at Consolidated Vultee Aircraft Corp., Fort Worth, Tex.

S. B. PARSONS is now associated with Johns-Manville Sales Corp. as territory salesman in their Automotive Section of the Transportation Department, St. Louis. Prior to this appointment he was industrial and fleet field engineer, U. S. Asbestos Division, Raybestos-Manhattan, Inc., St. Louis.

CARL J. BOCK has been appointed chief engineer of GMC Truck & Coach Division, General Motors Corp., to succeed C. O. BALL, who is retiring, but will be retained as a consultant. An SAE member since 1920, Mr. Bock served as vice-president for the Truck, Bus, & Railcar Activity in 1938-39, was a member of the SAE Ordnance Advisory Committee and other technical groups of the Society. Mr. Ball also has been active on various SAE committees, and has represented the Society on ATA and ASRE technical committees

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Previously service department inspector, R. B. Rogers Companies, Inc., New York City, **LOUIS CIMBORSKY** is now sale and service engineer, Cummins Diesel Sales & Service of New York, Inc., New York City.

Formerly an ensign in the U. S. Navy, **FREDERICK F. TRACY** is now assistant project engineer propeller laboratory, Air Materiel Command, Wright Field, Dayton, Ohio.

ROBERT H. GRIFFITHS now employed by the Cell-U-Plastic Co., Newark, was formerly engineering draftsman, Wright Aeronautical Corp., Wood-Ridge, N. J.

Previously field engineer, Wright Aeronautical Corp., Wood-Ridge, N. J., **DONALD R. HERBERT** has been appointed powerplant engineer at Beech Aircraft Corp., Wichita, Kans.

An engine tester, Experimental Department at Wright Aeronautical Corp., Wood-Ridge, N. J., **JOHN V. McELGIN** was, prior to this assignment, a private in the U. S. Army Air Forces.

District Manager **MURTY R. CALLAHAN** has transferred from Walker Mfg. Co., Racine, Wis. to Maremont Automotive Products, Inc., Chicago.

A former engineer at J. I. Case Co., Racine, Wis., **MARION C. TRAVIS** is now connected with Sealed Power Corp., Muskegon, Mich.

Having been discharged from the U. S. Army, **EDWARD L. KOENIG** has returned to Chance-Vought Aircraft as liaison engineer.

Managing partner at Fritz Bearing Co., Los Angeles, **T. H. COLGROVE** was formerly factory representative for Globe Bearing Co., Los Angeles.

O. A. RADERMACHER is now affiliated with A-R Auto Parts Co., Paw Paw, Mich., as purchasing agent.

JOSEPH CRAIG has been appointed technical director at Norton Motors, Ltd., Birmingham, England. Prior to this, he was development engineer, Associated Motor Cycles, Ltd., London.

Recently appointed service engineer at Kelite Products, Inc., Portland, Ore., **THEODORE E. BOKEMEIER** was formerly service manager, Bunting Tractor Co., Burley, Idaho.

JOHN HENDERSON WHYTE formerly district representative Tame Co., St. John, New Brunswick, Canada, is now connected with British

T. E. "TED" ALLEN, until recently executive vice-president and general manager of the Brake Lining Manufacturers Association at New York, has resigned that position to become assistant to president on public and industrial relations at Thermoid Co., Trenton, N. J.

MANNING STIRES, JR., has become vice-president in charge of Southwest properties at the Midland Oil Corp., New York City. He will be located in Post, Tex. Previously he has been associated with the Civil Aeronautics Administration in Washington, D. C. and Curtiss Wright Corp., Caldwell, N. J.

American Oil Co., Ltd., Montreal, as technical service engineer.

DR. VLADIMIR L. MALEEV has resigned from the position of consulting engineer with Harvey Machine Co., Inc., and has been appointed lecturer in mechanical engineering at the University of Southern California to teach machine design and design of internal combustion engines.

JOHN M. HILDT, JR., has been named meteorologist for American Overseas Airlines, La Guardia Field, N. Y.

After graduating from Yale University, New Haven, Conn., **KEITH WILLIAM STICKLE** became mechanical engineer, Westinghouse Air Brake Co., Wilmerding, Pa.

P. EDWARD BARDSLEY, who was assistant chief inspector, is now assistant sales and service manager, Delco Remy Division, GMC, Anderson, Ind.

FRANCIS GALDO is now structural designer for U. S. Rubber Co., Detroit.

NORTON WIENER resigned from Hoffman Radio Corp., to become associate mechanical engineer, Los Angeles Department of Water & Power.

Formerly chief tool engineer with Multi Products Tool Co., **ROBERT U. WHITNEY, JR.,** is now design engineer, Design Service Co., Newark, N. J.

GENE H. WHITE has been appointed assistant plant superintendent of the Hydraulics Division, Saval Co., Los Angeles, Calif.

DOROTHY M. SHACKELFORD, research engineer, American Locomotive Co., has been transferred from Schenectady to New York City.

SEYMOUR TILLES who was recently discharged from the Navy, is now a business representative in training for Consolidated Edison Co., N. Y.

SAMUEL UNTERMYER is now analytical engineer, NEPA Division, Fairchild Engine & Aircraft Co., Oak Ridge, Tenn.

Previously liaison engineer, **JACK H. WALDNER** has been promoted to research engineer, Kaiser-Frazer Corp., Willow Run, Mich.

THOMAS M. WALSH is now connected with the Neibauer Bus Co., Bristol, Pa., as superintendent of maintenance.

A graduate of Purdue University, **JOHN H. FALGE** is now affiliated with Inland Mfg. Division of General Motors Corp., Dayton, Ohio.

WALLACE J. SQUIRE is now employed as chief engineer for New England Auto Products Corp., Pottstown, Pa.

Exasperated at the slowness of his daughter and her chums in learning to knit, JOHN H. LOERCH, professor of hydraulics, Detroit Institute of Technology, learned to do it himself and drew up simplified instructions on the art for the children. Prof. Loerch is shown here with two of his neighbor's children

A former major in the Army, **EMMONS S. LOMBARD** is now property disposal officer, War Assets Administration, Washington, D. C.

RICHARD R. LOVELL who served as a captain in the Army is sales engineer, Original Equipment Division, Walker Mfg. Co., Jackson, Mich.

Formerly principal automobile adviser serving in the Army **JOHN TAAFE** is now real estate salesman for McClure & Hoffman in Tampa, Fla.

Prior to becoming production engineer for Western Electric Co., Baltimore, Md., **OMAR H. SOMERS** was mechanical engineer.

WARREN V. PRINCE, who was president and chief engineer of the Prince Industrial Plastics Corp., Cleveland, is now doing consulting work in Kansas City, Mo.

R. S. BEGG has been transferred from the engineering department of General Motors Corp., Detroit, to General Motors-Holden's, Ltd., Port Melbourne, Australia.

Moving from Tulsa where he was general supervisor of inspection for Spartan Aircraft Co., **JOHN G. KIRKHUFF** is now construction superintendent of Spicers Construction Co., Oklahoma City, Okla.

Resigning his commission as a lieutenant in the U. S. Navy, **DAVID C. MILLER** is a partner of West Warren Willys Sales & Service, Dearborn, Mich.

WESLEY S. ROPER has been named chief engineer of Wheeler Mfg. Co., Portland, Ore., having resigned from Beardsley & Piper Co., Chicago, as foundry layout engineer.

Transferring from the Owasso Division of the corporation, **WILLARD B. PAINE** is now staff assistant of the Detroit plant of Bendix Aviation Corp. For the past 15 years he has been with various divisions of the Bendix organization.

ROBERT E. HUNT has joined Rheem Mfg. Co., Eddystone, Pa., manufacturers of automatic machinery, as a design engineer. He had been with RCA Victor Division, Radio Corp. of America, at Camden, N. J.

Returning to his studies following service with the U. S. Army, **HORACE D. TAYLOR** has entered the University of California, Santa Barbara. He had spent three and a half years with Lockheed Aircraft Corp. in its manufacturing engineering department.

HARRY S. RICHER has joined Andrew Ashton & Associates, Los Angeles. Prior to heading his own firm of designing engineers with offices in Burbank, Chicago, and Cleveland, he had been design engineer with Weston Hydraulics, Ltd., North Hollywood, Calif.

Formerly a field engineer with Square D Co., Milwaukee, **R. J. CORY** has been named to the executive staff of Wisconsin Magneto Co. of that city.

Transferred from Western Division of Caterpillar Tractor Co., **WARREN G. BROWN** is now staff engineer, re-

search department, of the company's San Leandro, Calif. plant.

Resigning from Pirnie Lee & Co., N. Y., **CLARKE A. RODMAN** has become affiliated with Fram Corp., research department, Providence, R. I.

Severing his connections with the Utility Trailer Sales Co., Los Angeles, **THEODORE T. CORRELL** is now associated with the Fruehauf Trailer & Equipment Co., Portland, Ore.

Graduating from the University of Colorado, Boulder, **FRANK D. SQUIER** is now sales engineer for the Ramapo Ajax Division of the American Brake Shoe Co., Denver.

RICHARD E. CREDE is foreman of the automatic screw department of Liviton Mfg. Co., Brooklyn, New York, manufacturer of electrical wiring devices. He had been a partner of Automatic Tool & Engineering Co., New York City.

Until recently chief engineer of National Linen Service Corp., **JAMES B. FRETZ** has joined Serv-Air, Inc., Raleigh, N. C., as aeronautical engineer.

CHARLES ALAN JUDSON has been appointed senior lecturer in the propulsion department of the College of Aeronautics, Cranfield, Bucks, England. He had been an aeronautical engine designer with Rolls-Royce, Ltd., Derby.

Following numerous assignments in the South Pacific, M/Sgt. **KARL O. BOTNEN** is assigned to Hawaii, where he can be located in care of the Schofield Barracks, U. S. Army.

A. K. LOWE has been appointed sales representative for Timken Roller Bearing Co. at the Seattle, Wash., office. He had been an engineer with Isaacson Iron Works, in that city.

COL. ARTHUR B. NICHOLSON, G. S. C., has been assigned to duty at the Headquarters Air Defense Command, at Mitchel Field, N. Y.

J. HOWARD PILE, who was editorial director and business manager of the magazine Fleet Owner, New York, has been promoted to general manager. Before that time he was vice-president and editorial director of Chek-Chart Corp., Chicago. He is a past-chairman of the SAE Chicago Section and is currently vice-chairman of the Metropolitan Section for transportation and maintenance.

ED DAGNER has been appointed sales manager of Peerless Trailer & Truck Service Co., Portland, Ore.

A. LUDLOW CLAYDEN, Sun Oil Co., missed his first SAE Annual Meeting since 1914 because he returned to his office only a few days before having recuperated from illness. Joining the Society in 1910, he has a high record of attendance at Summer and other national meetings.

Merger of Extruded Metals, Inc., Belding, Mich., with the Detroit Gasket & Mfg. Co., Detroit, was recently announced by **LLOYD H. DIEHL,** president. The Extruded Metals Division will continue to serve the automotive, refrigeration, building, cabinet, transportation and industrial industries with extrusions, and in addition supply products fabricated from extrusions.

JOHN S. KILLALY has become process engineer, I. T. E. Circuit Breaker, Philadelphia.

JOE A. McCARTNEY, formerly project engineer, McQuay-Norris Mfg. Co., St. Louis, has resigned to become chief engineer of McCartney Mfg. Co., Joplin, Mo. The company is developing a line of precision engineered power tools.

THOMAS J. MARSHALL has been appointed assistant sales manager of Federal-Mogul Corp., Detroit. He had been advertising and sales promotion manager of the company, and will continue to direct the corporation's advertising in his new position.

FRED W. PARKER has been appointed assistant to the president at the Timken-Detroit Axle Co. Prior to this appointment, he had been director of service. Mr. Parker has been associated with this company for the past 20 years and has served in the engineering, sales and service departments.

PROF. RALPH H. UPSON, who had been consulting engineer, New York University, has been appointed professor of aeronautical engineering, University of Minnesota, Minneapolis. A former vice-chairman for aeronautics of the SAE Detroit Section, Prof. Upson has served on several SAE committees.

ROBERT L. STANLEY, who resigned recently from the faculty of Union College, Schenectady, has been appointed associate professor of engineering research, Engineering Experiment Station, Pennsylvania State College. He was the 1945 chairman of the Mohawk, Hudson SAE Group.

After his discharge from the Navy, **WILLIAM D. LEWIS** became connected with the Ingersoll-Rand Co., Phillipsburg, N. J.

Formerly district manager for Purolator Products, Inc., **V. H. RHODES** is now territorial sales manager, Drico Industrial Corp., New York City.

DWIGHT M. MOORE is now design engineer for Consolidated-Vultee Aircraft Corp., San Diego, Calif. He was formerly flight service engineer of the same company.

Resigning as service representative for United Aircraft Service Corp., East Hartford, Conn., **CHARLES HENRY PETTIS** is now employed as foreman of engine tests for Airwork Corp., Millville, N. J.

Until recently a lieutenant in the U. S. Army and stationed in San Francisco, **JAMES P. McSWEENEY** has been named a personnel instructor by Electro-Motive Division, General Motors Corp., LaGrange, Ill.

Transferring from Heyer Products Corp., **EDWARD S. COBB** is with Atlas Supply Co., Newark, N. J., as sales engineer.

Previously president of Republic Aviation Corp., Farmingdale, L. I., **ALFRED MARCHEV** has been elevated to the chairmanship of the same company.

"Diesel Operation and Maintenance" written by **ORVILLE L. ADAMS** contains a discussion of the fundamental, scientific and practical aspects of the problem of diesel operation and maintenance. The text is supplemented with line drawings, half-tones, blueprints and many tables, charts and graphs presenting essential information on engine dimensions, clearances, wear limits and so forth. It sells for $5.00.

DR. ALFRED J. BUCHI, who was president of the Buchi Syndicate, is now mechanical engineer at the Swiss Institute of Technology, Zurich, Switzerland.

Having seen service in the Royal Canadian Navy, **THOMAS O. MANTLE** has been appointed manager of Ambassador Parts, Ltd., automotive distributor, Windsor, Ont.

CLIFFORD R. FEILER, formerly with Busch-Sulzer Bros. Diesel Engine Co., has joined the Springfield, Ill., plant of Allis-Chalmers Mfg. Co.

Service Manager **RUSSELL WILLIAM MEALS** has transferred from Grand River Chevrolet Co., Detroit, to Nash Central Sales, Cincinnati.

Formerly a captain on the British Army Staff, Detroit, **HUGH M. COLE** has joined Canadian National Railways, Winnipeg, Manitoba, Canada, as supervisor stationary boiler plants.

NORMAN F. HINDLE has accepted a position as associate professor of mechanical engineering, University of Idaho, Moscow, Idaho. Prior to this appointment he was director of technical development program, American Foundrymen's Associated, Chicago.

Becoming production mechanic, McCullough Motors, Inc., Los Angeles, **HOUSTON A. DAMRON** was previously an ensign in the U. S. Navy.

Resigning as chief engineer at Fitz-John Coach Co., Muskegon, Mich., **W. E. WILLIAMS** is now new development engineer at ACF-Brill Motors Co., Philadelphia.

LEWIS W. PIFER is now president of Pifer Industries, Inc., Durham, N. C.

FRANK MICKA, JR. has recently been appointed DC-6 project supervisor, at Pan American Field, Miami.

Prior to becoming a designer at Byrl D. Phelps, San Diego, **ROBERT**

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OBITUARIES

EDWARD A. ROSS

Edward A. Ross, a Hawaii Section member, passed away in Honolulu on Jan. 21.

He was born in Rhode Island in 1887 and came to Hawaii in 1912, where he became associated with the Hawaiian Contracting Co. Here he started as master mechanic and rose to plant superintendent, the position he held at the time of his death.

R. JAY BURROWS

Robert J. Burrows, 64, a vice-president and director of the Clark Equipment Co. for the last 30 years, died unexpectedly on Jan. 12, in Hollywood, where he was spending the winter.

He was a pioneer in the automotive, industrial tractor and modern street railway equipment, and was primarily responsible for organizing and developing three of the seven divisions of the company at Battle Creek, Mich.

Mr. Burrows was born Nov. 28, 1882, in Youngstown. After graduating as a mechanical engineer from Clarkson College of Technology, Potsdam, N. Y., he joined the Weston-Mott Axle Co. in Flint. In 1913 he became chief engineer and general manager of the Lee & Porter Co., which manufactured axles, first for buggies and then for early automobiles. He then became associated with the American Gear Co. of Jackson and in 1915 he joined the Clark Equipment Co., becoming a vice-president and director.

In 1935, Mr. Burrows fostered development of modern standardized street cars, and in 1940 he was responsible for the design and construction of a 2000 passenger train now in operation on the BMT subway in New York City.

CLAIRE L. BARNES

Claire Leroy Barnes, president of Bendix Helicopter, Inc., and founder and director of the Houdaille-Hershey Corp., died in New York City on Jan. 16 at the age of 66.

Born in Comstock, Mich., he began working in a factory at the age of 15. Then he was associated with the Kalamazoo Radiator Co. which was purchased later by the American Radiator Co., where he was made assistant treasurer. In the meantime he attended evening sessions and graduated from Kalamazoo College.

He organized the Detroit Steel Products Co. and became its secretary and sales manager. In 1913, John North Willys, president of Willys-Overland, Inc., made him his assistant in charge of purchasing.

Three years later, he founded the Barnes Foundry & Mfg. Co. of Detroit, and became its president. Some years later he reorganized the Oakes Co. of Indianapolis. In 1929, Mr. Barnes merged that company with two others he had formed, the Hershey Corp. and the Houdaille Corp., into the automobile firm which combined both names. He retired as its president in 1940, but remained as a director and a member of the finance committee.

At the request of the late Vincent Bendix, Mr. Barnes returned to active business in 1944 to aid in the formation of Bendix Helicopter.

RICHARD EDSON MARSTON

Richard E. Marston, a member since 1922, passed away on Dec. 20, 1946.

After his graduation from college, he moved from Baltimore to Indianapolis, where he joined Howard Marmon's organization which was developing that automobile. Later he became connected with the Packard Motor Car Co., remaining until 1918, when he became assistant engineer for the Seldon Truck Co., Rochester. In 1920 he was appointed chief engineer.

Mr. Marston was an energetic member of the Philadelphia Section.

HENRY NORWOOD WILLIAMS

Henry N. Williams recently passed away while attending a convention of the Shrine at their annual initiation.

He was superintendent of maintenance for the Auto Interurban of Spokane. During 1945 and 1946 he was very active on the membership committee and was chairman of the Spokane reception committee.

Mr. Williams was a charter member of the Spokane Group and one of its hardest workers.

TECHNICAL COMMITTEE PROGRESS

SAE TECHNICAL BOARD

A. T. Colwell, Chairman

W. G. Ainsley — William Littlewood
B. B. Bachman — R. H. McCarroll
W. J. Blanchard — Elmer McCormick
L. Ray Buckendale — G. A. Page, Jr.
R. E. Cole — C. R. Paton
J. M. Crawford — D. G. Roos
W. P. Eddy, Jr. — C. G. A. Rosen
J. H. Hunt — A. W. Scarratt
R. M. Insley — Mac Short
R. D. Kelly — T. C. Smith
G. W. Laurie — V. C. Young

J. C. Zeder

SAE Standardization Embraces Gas Turbine Design and Materials

SAE technical committee activity has extended itself to meet both engineering and metallurgical problems in the field of aircraft gas turbines to accelerate development and application – both military and commercial – of this new type of propulsion. Two new committees created for this purpose are Committee E-22, Turbine Engines, and the AMS Heat-Resistant High-Density Alloy Committee.

Gas turbine pioneers are experiencing conditions never before encountered with reciprocating engines. Temperatures are much higher . . . compressors revolve faster . . . operating and design principles differ . . . even performance is expressed in new terms. Designers, manufacturers, and operators consider SAE a fruitful medium for exchange of ideas and for cooperation toward simplification of these mutual problems.

Engineering effort will be conserved by eliminating duplication of design and development of minor details. Each manufacturer's competitive position will be enhanced by switching emphasis from minor details to critical characteristics related to performance and suitability of application.

Standardization will reduce the cost of many items. Producer-customer cooperation toward maximum simplification of supply and maintenance problems can be achieved. Individual and overall industry progress will be accelerated by providing economical and ethical exchange of information.

Chairman O. E. Rodgers, Westinghouse Electric Corp., reported that Committee E-22 will act as a steering committee on both propulsion and auxiliary type gas turbines and ram jets (if needs in this area arise). New projects will be recommended either to other groups under the SAE Aircraft Engine Subdivision or to subcommittees of E-22 established to pursue specific problems.

A program requiring immediate action laid down by the Committee at its first meeting was divided

into two parts – work to be recommended to other groups and projects to be undertaken by E-22 itself. Items in the latter category include instrumentation, ignition connectors, fuel drain plugs, oil pressure regulators, oil filter dimensions, high-speed bearings, tooling, and tail pipe connections.

Apparently several companies have done considerable work on several phases of instrumentation and committee members will decide at their next meeting just what items of instrumentation should be handled. While it was agreed that taking positive action now on ignition plug connectors was not feasible, the Committee did form a tentative subcommittee composed of L. F. Smith, Taylor Turbine Corp.; T. M. Jack, Ranger Aircraft Engines, and C. W. Laubin, of Frederic Flader, Inc., to determine, by a series of surveys, what action might be taken.

Fuel Drain Plugs Studied

Possibilities of standardizing clearance requirements, operating conditions, and mounting connections of fuel drain plugs will be considered after a study of the problem. Benefits of standarizing oil pumps and pressure regulators also will be discussed at the next meeting. Since oil filters for gas turbines differ in size and performance from those used in reciprocating engines, a survey will be conducted of desired filter characteristics with the ultimate goal of developing dimensional standards.

Need exists for considerable data on high-speed bearings. Although the British compiled such information during the war, no similar work was done in this country. Chairman Rodgers appointed a subcommittee to report on the entire anti-friction problem. Another group will consider existing types of tail connections and flexible joints and will write a set of requirements for these units from the engine standpoint.

A group with which the Gas Turbine Committee intends to work closely is SAE Committee S-25, Standard Parts. First job Committee E-25 will be requested to undertake is the development of a coding system for identifying temperature applications for standard parts such as bolts and nuts. Need also exists for development of standard parts themselves – nuts, bolts, rivets, cotter pins, and washers of stainless steel and high-temperature lock nuts. Standardization of enclosed high-speed oil seals is another gas turbine to be proposed for Committee E-25's agenda.

Chairman Rodger's conferees also will cooperate with the new AMS High-Density Heat-Resistant Committee. This group intends to eliminate one of the most serious problems facing aircraft jet engine designers today – selection of satisfactory materials.

Form of Material	Commercial Trade Alloy Designation
Bars, billets, and forgings	AISI 347 (Revised AMS 5645D)
	AISI 310 (25-20) Low Silicon
	Universal Cyclops Alloy 19-9DL
Billets and forgings	Timken Alloy 16-25-6
Bars	Westinghouse Alloy K42B
Forgings	Wright Aero Corp. 8175 (Inconel X)
Seamless tubing	AISI 304 (Revised AMS 5560B)
Sand castings	AISI 403 or 410
Sheet	AISI 310 (2520) High Silicon

All companies involved in the jet engine business – steel and alloy suppliers, engine and accessory manufacturers – are on the search for materials to withstand operating temperatures of 1500F to 1700F. Critical components exposed to such temperatures are turbine blades, rotors, shrouding, and tail cones.

Objectives of this Committee is the development of a useful series of jet engine alloy specifications by screening and sifting materials in use today and selecting those that appear to be most satisfactory. Number of materials specified will be kept to a minimum for simplicity. These specifications must be kept up-to-date with the changing metallurgical art, advised Chairman A. W. F. Green, Allison Division, GMC.

The Committee is devoting much of its efforts toward materials for new developments in precision investment casting (lost wax process) such as vitallium and multimet. Proposals are now before the Committee for various types of stainless steels such as those listed in the table above.

These and other specifications will be reviewed by the Committee in developing Aeronautical Material Specifications as a guide post for selection of satisfactory jet engine materials.

Membership on Chairman Green's jet engine alloy committee is not permanent. This ruling, governing all AMS commodity committees, emphasizes that engineers and metallurgists from all interested users and producers of these materials are welcome to participate in meetings of this committee.

Serving with Chairman Rodgers on the Turbine Engine Steering Committee are: T. M. Jack, Ranger Aircraft Engines; W. G. Ovens, Wright Aeronautical Corp.; E. M. Phillips, General Electric Co.; R. M. Williams, Aircraft Engine Division, Packard Motor Car Co.; R. P. Atkinson, Allison Division, GMC; G. E. Beardsley, Pratt & Whitney Aircraft, and Whitney Collins, Continental Aviation & Engineering Corp.

Revamped Fuels & Lubricant Group Sparks Vehicle Lubricant Definitions

AMID reorganization of the SAE Fuels and Lubricants Technical Committee emerges news of a recently approved nomenclature and definition of crankcase oil types (developed by the American Petroleum Institute) plus the launching of a similar project on transmission and axle lubricants.

Revamping of the Committee, formerly known as the Lubricant Division, entails an enlarged scope and rearrangement for streamlined handling of projects. Both classification programs – the one approved for crankcase oils and the recent undertaking for transmission and axle lubricants – are aimed at dispelling the present confusion in selection of these products.

Meaningful definitions have been established by API and will be included in the 1947 SAE Handbook as general information for three types of engine oils – Regular Type, Premium Type, and Heavy-Duty Type. This new nomenclature classifies oils in terms other than viscosity. It gives consideration to other lubricating qualities and provides the user with a practical index for selection of an oil for each kind of service.

Chairman E. W. Upham
SAE F&L Technical Committee

It should prove useful for inclusion by manufacturers in vehicle instruction manuals. Private and commercial operators who do not purchase oil by

specification now have a rational basis for selecting engine oil.

The crankcase oil types are designated as follows:

- Regular Type – Motor oil generally suitable for use in internal combustion engines under moderate operating conditions.
- Premium Type – Motor oil having the oxidation stability and bearing corrosion preventive properties necessary to make it generally suitable for use in internal combustion engines where operating conditions are more severe than regular duty.
- Heavy-Duty Type – Motor oil having the necessary oxidation stability, bearing corrosion preventive properties, and detergent dispersant characteristics necessary to make it generally suitable for use in both high-speed diesel and gasoline engines under heavy-duty service conditions.

Arrived at by the Lubrication Committee, of the General Committee, of the Division of Marketing, of the American Petroleum Institute, these definitions were circulated by the SAE Fuels and Lubricants Committee to the petroleum trade press, fleet operators trade press, and a representative group of fleet operators. Reactions of these wide interests were evaluated by the Committee, serving as a basis for agreement.

Early this year the API Board of Directors approved these definitions.

Transmission and Axle Lubes

Selecting proper transmission and axle lubricants for a particular type of service is another need the Committee intends to fill. Work is under way for development of general information bearing on selection of these products along the same lines as those for engine oils.

Lubricants for conventional transmissions and axles for various kinds of operating and service conditions are being considered.

The recent committee reorganization includes a revamped sub-committee structure and an enlarged scope, Chairman E. W. Upham, of Chrysler Corp., reported. Most important change in the group's scope is the addition of fuels to its bailiwick, whereas its predecessor, the Lubricants Division, restricted its activities to lubricants.

Six standing sub-committees have been created – three on fuels and three on lubricants – with the following chairmen appointed:

- Subcommittee A – Transmissions and Axle Lubricants, H. L. Moir, Pure Oil Co.
- Subcommittee B – Engine Lubricants, H. C. Mougey, General Motors Research Laboratories
- Subcommittee C – Chassis Lubricants, C. W. Georgi, Quaker State Oil Refining Corp.
- Subcommittee D – Motor Fuels, A. J. Blackwood, Standard Oil Development Co.
- Subcommittee E – Aviation Fuels, T. B. Rendel, Shell Oil Co., Inc.
- Subcommittee F – Diesel Fuels, G. C. Wilson, Universal Oil Products Co.

A seven-man executive committee, balanced between the automotive and petroleum industries, will be appointed by the chairman. Term of office on the executive committee will run for three years. Membership will rotate, one new member from each field being appointed every year.

Executive committee for the coming year appointed by Chairman Upham is as follows: M. D. Gjerde, vice-chairman, Standard Oil Co. of Indiana; J. M. Campbell, General Motors Research Laboratories; J. C. Geniesse, Atlantic Refining Co.; J. L. McCloud, Ford Motor Co.; F. L. Miller, Standard Oil Development Co., and S. W. Sparrow, Studebaker Corp. (Chairman Upham is also a member.)

SAE Technical Board's stamp of approval has been given on this plan of operation and the Committee is swinging into action on projects under the new set-up. The transmission and axle lubricant classification being developed by Subcommittee A is an example.

Plan Better Bearings and Lubricants To Reduce Chronic Plane Maintenance

LONGER-LIFE aircraft bearings and lubricants are being pursued by SAE Committee S-5 through development of both improved specifications to meet modern operating conditions and test procedures to evaluate these bearings and lubricants.

In tackling this job, Chairman R. R. Rocholt, Lockheed Aircraft Corp., and his Committee recognized that crux of the aircraft bearing problem is a satisfactory bearing and lubricant combination. The overall task was broken down into three categories and assigned to the following subcommittees:

1. Subcommittee S-5A, Environmental Zoning – Chairman, F. B. Bolte, North American Aviation, Inc.

2. Subcommittee S-5B, Bearings – Chairman, H. L. Potter, Fafnir Bearing Co.

3. Subcommittee S-5C, Lubricants – Chairman, D. H. Moreton, Douglas Aircraft Co., Inc.

These groups are faced with the task of improving bearings and lubricants which today do not meet service conditions demanded of airplanes in extreme temperatures – from a runway under a tropical sun to subzero cold of arctic and high-altitude flying. Aircraft controls require better seals and a lubricant that retains its stability at high temperatures and still performs satisfactorily at low temperatures.

Failures from Poor Sealing

Inadequate sealing of bearings results in picking up of metallic chips and debris during fabrication of the airplane and service operation. Foreign matter combined with inadequate corrosion resistance can completely freeze the bearings and result in high loads on the control system.

Unstable lubricants tend to break down under high temperature and bleed out of the bearing. This leads to corrosion and eventually failure of the bearing.

Operators report that maintenance and servicing bearing failures and making replacement in inaccessible places swells operating costs to an excess. Seriousness of this problem is explained by the fact that servicing and replacement of a bearing during operation may exceed the original bearing cost itself many times – as much as 100 times in some cases.

Report Recently Issued

Groundwork for bearing and lubricant minimum performance specifications and evaluating test procedures was laid by Subcommittee S-5A in a recently issued report entitled "A Survey of the Environmental and Design Requirements Desired for Aircraft Bearings and Lubricants."

The report aims to clarify, for bearing and lubricant manufacturers, the operating temperatures and conditions that airplane manufacturers and operators believe should be met by these products. Two types of aircraft are considered – high-altitude or winterized military and commercial airplanes and medium altitude commercial and military aircraft for temperate zone operation.

Practical ground temperature range for unsheltered aircraft, says the report, can be established as −50F to +160F. In flight, a practical range of −65F to +165 F is recommended for high-altitude aircraft. For medium temperature operation, a range of −40F to +300F is specified. This also applies to heat-generating units and units in heated areas of high-altitude and winterized aircraft.

The report aslo observed that aircraft components exposed to alternating low and high temperatures will collect condensed moisture. Unless ac-

cumulated moisture is drained from critical units or surfaces, malfunctioning of the unit due to corrosion from or freezing of the condensate may result. This effect may stem from changes in air temperatures during flight and on the ground.

Bearing design should be such that they may be cleaned in service with pressurized steam, hot water, or solvents to which alkaline detergents or emulsifiers usually are added. The report also states that provision for easy purging and relubrication should be made to prevent premature failure of unsealed bearings from the removal of grease.

Bearings (plain and antifriction) should not lock when tested with lubricant for one hour with the temperature gradually reduced from —65F to —90F. General purpose grease for medium altitude must not lock bearings at —50F and should provide good lubrication at +300F with no deleterious effects after prolonged exposure. Both of these lubricants should have good corrosion-inhibiting qualities, the survey revealed.

Sealed antifriction bearings must retain the lubricant at elevated temperatures and exclude foreign matter and cleaning material. Sealing material should be resistant to the lubricants used and temperatures encountered. Corrosion-resistant bearings are desired for slow rotating parts.

Operators questioned said that service failures with antifriction bearings greatly exceeded expectations – one type of airplane requiring an average of 250 man-hours per month for repairs traced directly to anti-friction bearing failures. Correction of this dangerous and costly condition lies in these two alternatives:

1. Use of plain bearings wherever possible;

2. Improvement in lubricating materials and antifriction bearing design.

With this report as a guide, the bearing subcommittee has agreed (1) to prepare an improved testing procedure for rating different manufacturers' bearings and (2) to develop minimum performance specifications for aircraft control bearings to insure proper functioning under wide temperature ranges and other environmental conditions.

The performance specifications are to be used for both purchasing and inspection.

This group plans to accelerate improved bearing performance by encouraging better designs and improved maintenance practice. It plans to prepare engineering data as a ready reference for designers. Also it hopes to assist users by showing where ball bearings can be replaced by plain bearings and by advising of correct bearing applications.

80% of Aero Industry Favors Decimal Use

RETURNS on an industry-wide survey by the SAE Aeronautical Drafting Committee show that 80% of the aeronautical industry is using, or contemplates adoption of, the decimal dimensioning system.

To serve as a guide to the committee in its work on dimensioning in the SAE Aeronautical Drafting Manual, some 292 opinions were solicited of aircraft, engine, propeller, and accessory manufacturers and airline operators. (See p. 81 of the October, 1946, SAE Journal for details on the questionnaire.)

Majority opinion had it that decimal dimensioning offers the virtues of the metric system – long advocated by many – without the disruptive headaches that would result from conversion from the basic inch to the meter. Survey results were compiled on the basis of answers to four questions asked.

Questions and Answers

First question asked, "Has information pertinent to the decimal system of dimensioning, as outlined in the SAE Aeronautical Drafting Manual been made available for study and possible use to your company?" According to the returns, 76% of the entire industry has studied the decimal dimensioning system.

Second question read, "Does your company use the decimal system of dimensioning? If so, to what extent?" The survey showed that 75% of the industry is using decimal dimensioning, of which 63% is using it completely and 37% partially. Breakdown by each industry is as follows:

- Aircraft Manufacturers, 72% (65% full and 35% partial)
- Engine Manufacturers, 86% (83% full and 17% partial)
- Propeller Manufacturers, 80% (100% full)
- Airline Operators, 67% (25% full and 75% partial)
- Accessory Manufacturers, 70% (40% full and 60% partial)

Those answering "no" or indicating partial use to the second question were asked, "Is your company contemplating adoption of the complete system of dimensioning? If so, to what extent?" Summation of replies showed that 56.6% are contemplating its full adoption; 15% agree with the theory but are waiting to observe the trend; 2% depend upon their customers.

A flood of replies was received to the fourth question which asked why the company approves or disapproves use of decimal dimensioning. Typical is the following comment of an aircraft manufacturer:

"We adopted use of decimal dimensioning in order to make dimensioning of a drawing a quicker and easier process. Converting of fractions to decimals back to fractions is a time-consuming effort. Moreover, with the system adopted, it has made it very much easier to show the tolerance required by the use of additional digits after the decimal point. For example:

0.X has a tolerance ±0.05
0.XX has a tolerance ±0.03
0.XXX has a tolerance ±0.001

"Most of our dimensions are given in two-place decimals."

The committee considers the results of this survey a green light for expansion of recommendations on decimal dimensioning in the Manual.

Possible byproduct value of the survey, according to Committee Member P. J. Hayes, American Airlines, Inc., who summarized returns and comments received, is that it justifies promotion of "decimalism" in the education field. The Society for Promotion of Engineering Education should be advised, he feels, of current aeronautic industry practice so that decimal dimensioning can be incorporated in curriculum of engineering schools throughout the country.

Tests Will Expose Faulty Spark Plugs

PLANS for developing new spark-plug tests and revision of an old one reflect SAE Ignition Research Committee's objective of insuring more efficient aircraft engine ignition with a minimum of failures.

Action agreed upon by the Committee includes revision of ARP 159, Quench Bomb Spark-Plug Test, and preparation of two new tests to satisfy needs not covered by ARP 159 – (1) a procedure for inspecting plugs after use and prior to reconditioning and (2) a procedure for inspecting new or reconditioned plugs.

The test outlined in ARP 159 is designed to check only the electrical properties of the plug. Chairman A. L. Beall, Wright Aeronautical Corp., pointed out that the two inspections to be developed are necessary for several reasons. For one, ARP 159 procedure measures primarily insulation resistance of a cold plug at approximately 11 kv peak. It cannot detect plugs fouled with temperature-sensitive coatings or plugs with defective or punctured insulation near the top of the barrel.

He also said that checking plugs immediately after removal might completely exonerate plugs blamed for ignition troubles stemming from other sources. In one case, he recalled, an airplane with chronic ignition troubles

had the spark plugs changed many times – but without curing the malfunctions. Apparently another part of the system caused the trouble.

Checking the first set of plugs after removal would have made this evident immediately.

Discussions by spark-plug users and makers at the last committee meeting amplified the need for adequate spark-plug testing and inspection procedures.

Spark-plug failures fall into two categories, said Ernest Von Mertens, Pratt & Whitney Aircraft. First are those occurring during engine operation and second, those discovered when the plugs are removed. In the first group, his experience indicates the three following types are prevalent:

1. Ceramic body separation from the rest of the plug – 20-30% of total failures;

2. Barrel failure due to damage or vibration – 20-30% of total failures;

3. Failure from high temperature and melting of the center electrode – 25-35% of total failures.

Von Mertens attributed failures in the second category – barrel failures and small ceramic cracks – to mishandling and vibration. Although most cracks come from overheating, he felt that use of excessive water in water-injection engines also can crack the ceramic.

As an operator, C. E. Swanson, Northwest Airlines, Inc., remarked that his company found gap erosion responsible for 95% of spark-plug failures and the remaining 5% due to plug breakage, especially the ceramic barrel. As a result of experimentation with reduced spark-plug gap, he has standardized on an initial setting of 0.008 in. His company is convinced that the gap should not be set in excess of this value and is even trying a 0.006-in. gap.

According to information received by M. J. Carry, B G Corp. (spark-plug manufacturers), one airline finds unscheduled spark-plug removals caused 80% of station delays; other troubles were responsible for 16% of station delays, and 4% of station delays are directly traced to bad spark plugs.

A possible method of approaching these newly proposed inspection procedures was advanced by W. A. Bychinsky, AC Spark Plug Division, GMC. He felt that serviceable plugs should be selected by simple testing for easily determined characteristics and by eliminating those defects impractical to evaluate.

He divided plug failures and methods for their detection into these three groups:

1. Coatings or deposits – They may occur on insulated surfaces, electrodes, and between the insulator and electrodes or shell. Their effect on the plug is difficult to determine. The plugs should be cleaned and visually examined, eliminated the need for measuring deposits.

2. Mechanical failure or wear – Such defects as damaged threads and hexes, broken or missing components, cracked core insulator tips, and improper gap settings can be seen by eye or detected with gages.

3. Electrical defects – Aside from electrical failures eliminated by the above inspections, the center electrode structure can fail and the insulation deteriorate. Checking the resistance between the high-tension terminal and the sparking tip of the center electrode will detect any change in structure. Insulation defects not discernible by eye will be revealed by a flash-over type bomb test.

Committee membership change announced by Chairman Beall was the replacement of P. J. Kent, Chrysler Corp., by R. W. Eddy of the same company.

Check Motor Vehicle Interference With Video and Radio Reception

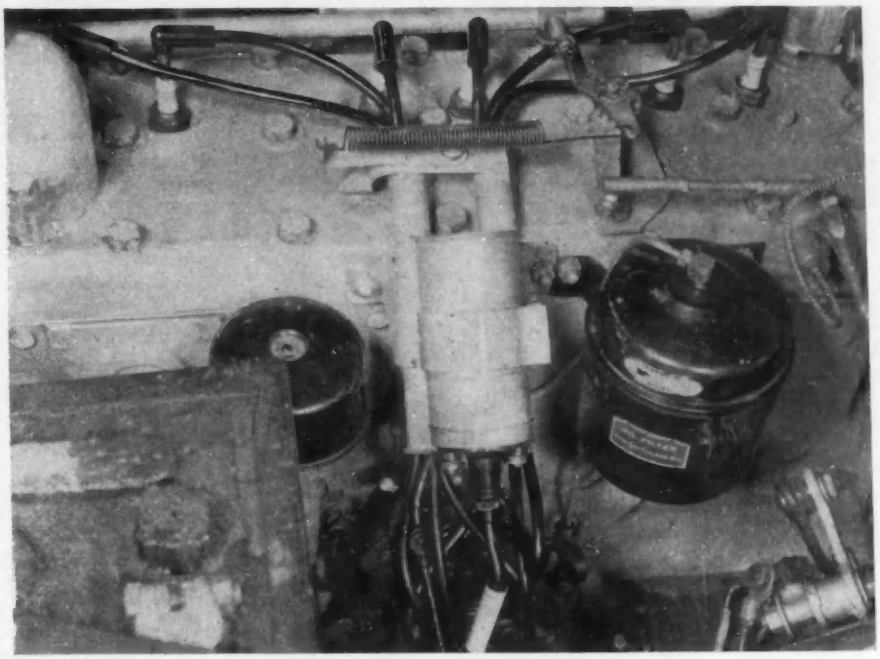


Fig. 1 – To keep vehicle electrical system radiation (interfering with television and high-frequency radio) within tolerable limits, field tests were conducted with cars modified as shown. 10,000-ohm suppressors have been installed on the spark plugs and the distributor centerlead

FOLLOWING two years of laboratory and field work by the joint SAE-RMA (Radio Manufacturers Association) Vehicle Radio Interference Committee, the Automobile Manufacturers Association has adopted that committee's recommendations for limiting vehicle electrical system interference with television and other high frequency radio reception.

The joint SAE-RMA Committee reported that receiver interference can be reduced to tolerable limits if vehicle electrical system radiation is kept within specified values by modifying the electrical system and by installing resistors in high-tension circuits. As a result of these conclusions, the AMA made the following recommendations to all bus, truck, and passenger car manufacturers:

1. That they begin immediately to prepare their vehicles to meet the recommended tolerable interference limits by Jan. 1, 1948, and with the exception,

2. That installation of resistors be deferred until more information is available.

With the trend toward universal use of high frequencies for entertainment broadcasting and television, as well as for many commercial and emergency communication services, annoying reception disturbances emanating from motor vehicles may become more pro-

nounced. The average individual has not been disturbed by vehicle electrical system interference because entertainment broadcasting presently is transmitted over the 550 to 1500 kc frequency band. Vehicle interference makes itself objectionable at frequencies above 1500 kc and probably reaches a peak in the 30-150 mc range. It is within this range that many new types of radio communication are being licensed by the Federal Communications Commission.

Radio Types Affected

Frequency modulation on channels between 84 and 102 mc is being used for both commercial and noncommercial programs. . . . Facsimile radio-transmission of sketches, drawings, and photographs – will use high frequency channels. . . . Television channels operate on frequencies of from 44 to 225 mc. . . . Aviation depends on high-frequency radio communication for safety of life and property in the air. Airlines report that cargo, mail, and fueling trucks in the ramp area can be a serious detriment to communications between the tower and flying aircraft. . . . Two-way radio for police cars and commercial vehicles such as trucks, buses, and ambulances operates within the area of interference.

To forestall annoyance from vehicle-generated interference with reception, both the SAE and RMA were requested to develop methods of alleviating these disturbances.

The committee felt that preparation of vehicles for interference elimination at the time of production is the most desirable method of handling the problem. The postwar period was considered a propitious time for making the necessary modifications in view of the anticipated high rate of replacement of prewar cars. Educating the old car owner to install suppression equipment is a problem. He receives no direct benefit from such an expenditure, unless he is the owner of a television or high frequency radio set.

Limit Ignition Radiation

As a result of numerous field tests, the committee established 35 microvolts per meter at 50 ft from the vehicle as the tentative tolerable value for motor vehicle electrical system radiation. (Minimum signal strength for satisfactory reception on commercial receivers is 50 microvolts per meter for FM and 500 microvolts per meter for television.)

To suppress vehicle radio interference within these limits, the committee recommended that these steps be taken:

1. Locate high-tension coil to permit an 8-in. or shorter lead from coil to distributor;

2. Keep primary electrical wiring, metal rods, and conductive tubing as far from high-tension wiring as possible;

3. Use a 10,000-ohm suppressor in the distributor-to-coil high-tension lead;

4. Use a 10,000-ohm suppressor at each spark plug.

Organized in February, 1944, the committee assigned study of the various problems to three subcommittees. The Radio and Television Receivers group, composed mainly of members of the radio industry, studied the amount of interference permissible for reception on FM, AM, and television receivers within the range of 0.55 to 150 mc. The second subcommittee, Vehicle Radio Interference, drew its membership from vehicle, radio and ignition manufacturers. It obtained data on the amount of radio noise from motor vehicles that interfered with reception over the spectrum from 0.55 to 150 mc. This group also studied interference from various makes of vehicles and developed methods of keeping it within tolerable limits.

Third working group, Measurement and Instrumentation, assisted the first two subcommittees with methods and instruments for measuring interference.

Tests Disclosed Data

Basic information was uncovered during field tests conducted at Anderson, Indiana, in June, 1944 and June, 1945 and at Rye, N. Y., in November, 1944. These tests disclosed how sensitive radio and television receivers really are to vehicle electrical system interference and provided data for suppression of vehicles. Figure 1 shows a vehicle after modification. Tests at Rye, conducted in conjunction with broadcasts by National Broadcasting Co. and the Columbia Broadcasting System, checked tolerable limits of vehicle electrical system radiation on the reception of several television and FM receivers.

To further the contribution made by the committee to date, it is being reorganized and expanded to conduct further investigations into the ways and means of suppressing vehicle radio interference.

Members of the original Vehicle Radio Interference Subcommittee were P. J. Kent, Chrysler Corp., chairman; J. H. Little, secretary, Chevrolet Motor Co.; L. L. Beltz, Packard Motor Car Co.; J. I. Cornell, Solar Mfg. Corp.; H. L. Hartzell, Delco-Remy Division, GMC; A. V. Nichol, Philco Radio Corp.; M. E. Piper, Colonial Radio Corp.; W. G. Schneider, Engineering Division, Electric Auto Lite Co.; F. C. Stromatt, Willys-Overland Motors, Inc.; C. W. Thomas, Ford Motor Co.; and T. E. Wagar, Studebaker Corp. Serving on the main committee were Mr. Kent and R. M. Critchfield, Delco-Remy Division, GMC, chairman of the SAE Electrical Equipment Committee.

SAE-AISI to Publish Over 60 Steel H-Bands

PUBLICATION jointly by SAE and AISI of all tentative steel hardenability bands developed to date should be available within several months.

A total of 62 bands are to appear in this publication instead of 87 as erroneously reported in an article entitled "Buyer Reluctance Retards Switch to H-Band Steels," on p. 72 of the December, 1946, SAE Journal.

The steels to be covered in the forthcoming publication, some of which appeared in the joint AISI-SAE Pamphlet "Tentative Hardenability Bands," published in 1944, are as follows:

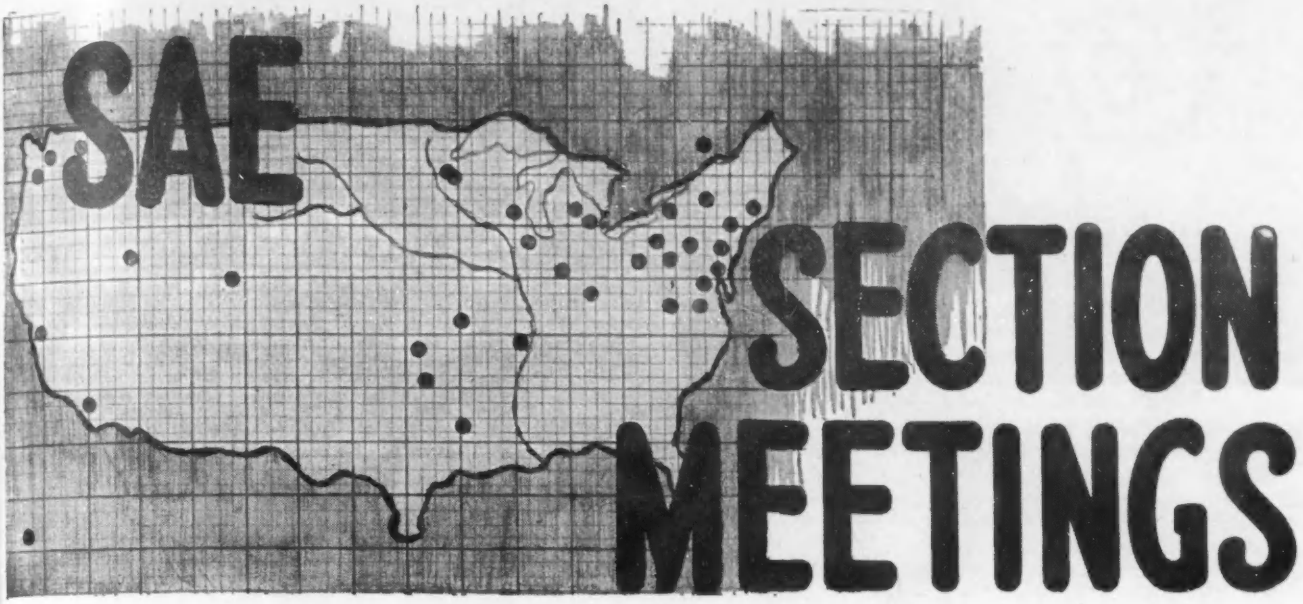
1320H	4145H	8617H	8660H
1330H	4147H	8620H	8720H
1335H	4150H	8622H	8735H
1340H	4317H	8625H	8740H
2512H	4320H	8627H	8742H
	4340H	8630H	8745H
2515H	4620H	8632H	8747H
2517H	4640H	8635H	8750H
3310H	4812H	8637H	9260H
3316H	4815H	8640H	9261H
4130H	4817H	8641H	
4132H	4820H	8642H	9262H
4135H	5140H	8645H	9437H
4137H	5145H	8647H	9440H
4140H	5150H	8650H	9442H
4142H	6150H	8655H	9445H

SAE Adding Plastics, New Rubber Tubing

INITIATION of standards for automotive plastics and the addition of a new coolant system hose classification recently was announced by the SAE Non-Metallic Materials Committee.

Chairman W. M. Phillips, General Motors Corp., is working in close liaison with the Society of Plastic Industries which is developing a plastic classification. The SAE Committee will consider adapting SPI-developed data applicable to automotive use as a standard in the SAE Handbook.

The new Class SC compounds for coolant system hoses are prescribed for applications requiring oil-resistant tubing. Two other moderate duty hose types in the Handbook are Class RN, based on reclaim compounds and intended for moderate service, and Class RS, based on synthetic rubber and recommended for normal service.



Complete Brake Test Procedure Described

by ARNOLD R. OKURO, Field Editor

NEW ENGLAND Section, Feb. 4—Brake engineers are victims of circumstances, R. A. Goepfrich of Bendix Aviation Corp. told this meeting. As loads and speeds have increased over the years, wheels have shrunk, until today there is hardly space enough for an adequate brake. Vehicles are satisfactorily stopped only because brakes have been so improved that we get more power from small diameter brakes than larger ones produced in the early days.

To properly test performance of a new brake, Goepfrich said, it should be tried under conditions as near like those encountered in service as possible. Time usually is against reproducing these conditions, so that tests are accelerated somewhat and performance is evaluated by comparing results with those of previous brake tests.

Brake dynamometer assembly consists of a motor-generator set for supplying power to drive the flywheel; the dynamometer for developing kinetic energy and measuring the force necessary to absorb this energy; and the control panel for regulating dynamometer and indicating and recording results. Tests can evaluate:

1. Effectiveness (relation of output to input)

2. Capacity (torque at which some part of brake fails)

3. Wear rate (rate of lining wear per given number of miles)

4. Wear pattern (distribution of wear)

5. Lining characteristics (effectiveness, wear, rate, fade, build-up, and so on)

6. Drum distortion (amount and location of drum deflections).

In addition, road tests are necessary to determine deceleration, speed, pedal pressure and pedal travel. An instrument panel is mounted in the truck cab of the test vehicle, and readings are recorded by an observer while the driver makes brake applications according to test pattern. Recordings are plotted on graph paper for analysis and comparison with other test results.

Other important elements in thorough brake testing that Goepfrich enumerated are temperature, which largely determines brake size for a given vehicle; lining wear rate, checked by accurate measurements at the beginning of the test and at intervals; and the effects of different terrain and consequent different kinds of braking.

Despite all recognized test methods, Goepfrich concluded, the human element warrants the utmost recognition.

Philadelphia Members Hold Inspection Trip

by R. W. DONAHUE, Field Editor

PHILADELPHIA Section, Jan. 8—In lieu of a regular meeting during Annual Meeting month, Philadelphia Section members made an inspection trip to the General Steel Castings Co. at Eddystone, Pa. Thirty-eight members were guided through the huge plant, whose facilities are devoted to the molding and machining of some of the largest castings made. The company specializes in railroad equipment.

Starting in the open hearth section, the group witnessed the pouring of a heat. Ladles of 70-ton capacity then poured the molten metal in castings for motor truck frames. Later they watched the machining of similar castings. They were particularly interested in the ease with which large castings were handled and machined.

Dayton Members Visit GMC Plant

by JAMES E. P. SULLIVAN, Field Editor

DAYTON Section, Jan. 16—Dayton Section members made a two-hour inspection trip through the GMC Moraine Products Division plant this afternoon. Of particular interest were the metal powder production departments, where bearings, filters, and structural parts are fashioned from metal powders through Moraine's powder metallurgy techniques. Use of these techniques also was seen in the friction material department where friction plates are made for automatic transmissions, and on the engine bearing strip line where metal powders serve as a matrix or bond between the steel back and the babbitt.

After dinner at the Van Cleve, Chairman W. H. Geddes conducted a brief business session and introduced the evening's master of ceremonies, Moraine Products' chief engineer V. P. Mathews. Speaker of the evening was Moraine's chief metallurgist, Roland P. Koehring, who presented an illustrated lecture on "Powder Metallurgy." He explained the background of powder metallurgy, as well as its present-day applications, potentialities and limitations.

Chicago Meeting Breaks Records

by PETER P. POLKO, Assistant Field Editor

CHICAGO Section, Feb. 11 – Some kind of record was broken in Chicago tonight when over 500 turned out to hear D. B. Baker, manager of engineering of International Harvester Co.'s Industrial Power Division, give a paper on "The Development of Harvester Diesel Engines."

SAE President C. E. Frudden topped a list of notables at the speaker's table and added interest to the meeting with a few words of greeting and reminiscence. Chicago Section membership and plant representative workers were invited as guests of the Governing Board. Chairman Oldacre paid special tribute to these men and their chairman, A. H. Winkler, for the good work done during the past year. Through incessant efforts of the hardworking Winkler, this group of plant representatives was able to attain third place in the national membership drive.

Speaker Baker, who has been with IHC for 43 years, described the years of intensive effort devoted to producing moderate cost engines for farm and industrial use, capable of giving efficient operation and satisfactory performance on low-grade fuels.

Diesel research and development, he said, have been guided by the search for better thermal efficiency and improved engine torque. Investigations took engineers to Germany to study the 4-cyl Dorner diesel engine . . . but unsatisfactory performance led International Harvester in 1930 to design its own single-cylinder, precombustion chamber engine. After exhaustive development work, they concluded that "the precombustion chamber type of diesel engine was less sensitive to wide variations in fuel quality, and was definitely superior to the open chamber direct injection engine in smoothness of operation on the fuels available at that time." "From 1930 to the present," Baker said, "the Harvester organization has been committed to the precombustion type diesel because of these characteristics. This principle has been followed in the company's three 6-cyl and three 4-cyl engines.

Baker said, in conclusion, that a diesel engine will consume from 17 to 32% less fuel, by volume than a gasoline engine of equivalent size. But because of the present higher initial cost of diesels, the diesel operator must run his unit for at least 600 hr per year before he can realize a savings over a gasoline unit of the same size.

A. W. Scarratt, International's vice-president of engineering and patents, showed that the factor of combustion control is of utmost importance in the diesel engine. Improvement in combustion will afford good opportunities for increased power and reduced cost. He reported that Harvester engineers have been able to attain satisfactory engine operation without smoke or detonation at a bmep well over 110 psi.

Raymond Bowers, Chicago Section's vice-chairman for tractors, industrial power, and diesel engines, arranged the meeting and introduced the speaker.

SAE President C. E. Frudden, who was a member of the Chicago Section 30 years ago, is shown speaking to the dinner audience at the Section's Jan. 11 meeting. Dinner attendance was 473

Chicago Section Chairman W. H. Oldacre congratulates A. H. Winkler on the accomplishments of his Membership and Plant Representatives Committee. New Section memberships to date are 17% above quota

Predicts "Comfortable" 2500-mph Rocket Travel

by ROBERT B. INGRAM, Field Editor

WILLIAMSPORT GROUP, Feb. 3 – Rockets are far from new, as history shows that the Chinese held back the hordes of Genghis Khan in 1232 with rockets. Today, A. K. Huse of Reaction Motors, Inc., told this meeting, "it is the fear of being surprised that is urging each country to spend millions of dollars for rocket research. England, for example, is building a $24,000,000 rocket range in Australia."

Huse discussed operating principles, rocket terminology, and types of rockets, and showed a number of slides of Reaction Motors rocket engines now being tested, including the 6000-lb regenerative thrust unit now powering the Bell XS-1 supersonic airplane.

Rocket gets its forward motion not from the push of the jet against outside air, but from push of the jet against the motor (Newton's third law.) Thus a rocket theoretically can travel at the speed of its jet. In turn, various jet speeds are possible with different propellants such as oxygen and alcohol and acid and analine.

The term "specific fuel consumption" means, in rocket terminology, the pounds of propellant consumed per sec per lb of thrust. Huse illustrated this term by showing that at a speed of 2500 mph it will be possible to get the same mileage per gallon from a rocket engine as a reciprocating engine delivers at 350 mph.

Rocket engine is particularly useful when a large amount of thrust is required for a short period of time, as Huse showed in slides of the Bell XS-1 supersonic plane with its 6000-lb thrust engine. For the same thrust, the rocket

engine is much lighter and more compact than a pulse or ram jet engine.

Future travel in rocket-powered planes, Huse predicted, will be comfortable and restful, and 2500 mph eventually will seem as normal as 200 mph does today.

Hilo Division Officers Named

by W. O. HARPER
Secretary, Hilo Division

HAWAII Section, Dec. 13 – Nine regular and 27 prospective members were present at this meeting of the new Hilo Division of Hawaii Section. Elected to serve as officers of the new Division were Chairman Howard Overman, A. F. Stubenberg Co.; Secretary W. O. Harper, Kaiwiki Sugar Co.; and Treasurer Byron Peetz, Laupahoehoe Sugar Co.

CLOSING DATE

SAE Journal strives, in these pages, to bring to Society members live, prompt news coverage of every Section meeting. Material is provided by section field editors.

With dates determined by printing schedules, this issue covers all Section meeting news received in New York up to Feb. 15.

Government Aid Urged For Flight Safeguards

by C. F. FOELL, Field Editor

METROPOLITAN Section, Feb. 4 – National welfare is allied to Government financing of air navigation aids for greater safety and regularity in commercial aviation, declared William A. M. Burden, Assistant Secretary of Commerce. Being chief of the CAA and the Weather Bureau added significance to his message.

Despite objections that the air transport industry has matured to the point where it can foot its own bills, he argued that Government assistance is entirely justified. Uncle Sam stepped in to lend a hand to other transportation industries – railroads and trucking – during their "growing pains" stage of development and the country as a whole has reaped dividends ever since.

By making air travel safer and assuring its regularity, human lives will be saved and a greater potential for contributing to our national economy will be built, Burden claimed. Helping the air transport industry increase its earning powers will add to the national treasury through taxes and will provide employment in both the building and operating of aviation equipment.

What form these all-weather flying devices should take was said to be a controversial issue. The two most prominent types are ILS (instrument landing system in which beams registering on instruments in the cockpit guide the pilot in on the proper glide path) and GCA (ground control approach system in which a ground crew observes the plane's position on a radar scope and talks the pilot in). The CAA has for the present adopted ILS and, according to Burden, 100 of these installations should be in operation throughout the country by this summer.

ILS is favored over GCA because it costs less – both in initial price and cost of operation.

Speed with which these devices are installed at all major airports was said to depend on the public. Only pressure from Mr. Average Citizen will cajole Congress into appropriating adequate funds for fulfillment of this program.

The meeting was arranged and conducted by J. M. Van Law, Section vice-chairman for air transport activity.

Local Speakers At Peoria Meeting

by E. S. TOMKINSON, Field Editor

PEORIA Section, Jan. 3 – Development of heavy earth-moving equipment still is a wide-open field, G. H. Gearhart told this meeting. Speaking on "Field Development of Heavy Earthmoving Equipment," the Caterpillar Tractor Co. engineer pointed out that despite improved efficiency of present machines, the alert field engineer can do much to decrease cost through new methods, new machines, and improvements. The design engineer, too, is in a position to make important contributions using facts collected in the field.

Ivan E. Howard, second speaker on the member-speaker program, spoke on lubricating problems in the field. Howard, who is lubrication engineer for Phillips Petroleum Corp., told of the classification of crudes by relative content of paraffin or asphalt, and by source. Many characteristics affect an oil's performance. But one quality taken alone, such as viscosity index, means little: proper evaluation requires consideration of all the oil's qualities. Thus present petroleum industry classifications (regular, premium and heavy-duty) are based on performance, not just physicals.

Concluding with a few "do's" and "don't's" Howard advised against using too light an oil and leaving it in the engine too long. He also advised against mixing brands, and pointed out the importance of maintaining proper engine temperature.

Basic principles of governor operation were discussed by G. B. Grim, Caterpillar research engineer, who emphasized the fact that a governor cannot anticipate load changes, but can act only after engine speed has changed. In automotive type engines, governor control only for low idle and maximum speeds can be achieved with manual control throughout the operating range by the use of two sets of flyweights or a single set of weights with two loading springs.

Hydraulic governor, Grim said, "cannot achieve closer speed regulation or greater speed stability than a purely mechanical governor. It merely permits magnification of the governing force."

For best operation, there must be a minimum of friction in working parts, and adequate lubrication. Flyweight forces should be kept moderate and sliding members avoided. Finally, the governor drive should be free of any speed irregularities.

Speakers at Peoria Section's Jan. 3 member meeting were (l. to r.) G. B. Grim, G. H. Gearhart and I. E. Howard

Engineer Gives Tips For Better Engines

by D. M. TREPP, Field Editor

NORTHWEST Section, Feb. 7 – Nearly 150 were present at one of this Section's best attended meetings. Keen interest in the field of gasoline, diesel and butane powerplants was indicated by the large attendance and the lively discussion that followed L. L. Bower's paper on "Redesigning for Improved Performance and Life of Modern Engines."

Many questions were shot at Bower, who is assistant chief engineer of Waukesha Motor Co., and his answers brought out some interesting predictions:

- Diesel fuel prices are rising, but economy still favors the diesel engine. Economy will drop, however, as higher octane fuels become practical.
- Diesel research and improvements have lagged behind progress in gasoline engines; when diesels catch up, further economies and advantages may emerge.
- Gasoline injection has possibilities, he believes, but present cost of equipment is too high.
- Passenger cars will have 85 octane gasoline soon, but cost is too great for truck use.
- Aluminum bearings carry better loads than babbitt, probably will be used extensively.

Predicted optimum compression ratio for gasoline efficiency was 10 or 11. A higher compression ratio will be possible in passenger cars than in commercial vehicles, Bower said, because of load factors.

Theme of Spokane Group's Dec. 13 meeting was "Safety on the Highways." Shown at the speakers' table are (l. to r.) Seated: James H. Ray, 1945-46 chairman; Sgt. J. G. Ellis, safety inspection officer, and Sgt. L. H. Thomas, safety education officer, both of the Washington State Patrol; Sgt. Harvey E. Hastings, safety control officer, Spokane Police Department; Police Chief G. S. Swartout, Spokane Police; Spokane Group Chairman Hugh P. Kanehl; Program Chairman Walter T. Thorsen. Standing: District Inspector Hiigle and District Supervisor Herbert H. Hauser, Bureau of Motor Carriers, ICC

Water Injection Opposed for Cars

by ROBERT B. INGRAM, Field Editor

WILLIAMSPORT Group, Jan. 13 – Alcohol-water injection probably will produce very little gain in passenger car performance, Clay Ballinger declared at this meeting. The plant manager of Darling Valve & Mfg. Co. based his statement on personal experience with a 1946 Ford equipped with 8.50:1 compression ratio cylinder heads and using an alcohol-water injection unit manufactured by Thompson Products, Inc. He believes most passenger cars are over-powered. Full throttle power output is seldom used, and part-throttle operation does not require alcohol-water injection to suppress detonation with present-day fuels.

He feels the best field for alcohol-water injection is in trucks making long hauls and using largely full throttle. Here, a lower octane grade of fuel might be used and the difference in octane number be made up by water injection. A considerable cost saving might be effected. Additional recommendation, Ballinger pointed out, is the resulting reduction in engine sludge and carbon deposit formation.

His experiment, he reported, did not show any noticeable improvement in economy, although it is known that increased compression ratios mean better economy. "Of course," he said, "this is not based on extensive engineering figures but only on the amount of money spent each week for gasoline. This is primarily what the average person is interested in."

Asks Research Now For Field Equipment

by BERTRAM ANSELL, Field Editor

WASHINGTON Section, Jan. 14 – There was little or no research and development for Quartermaster equipment before World War II, according to Herman B. Levitz of the Quartermaster General's Office, Research and Development Branch. As a result, the Army had to put equipment in the field based on designs carried over from the first World War.

Small engines used on field equipment proved to be a constant source of trouble. These engines were designed by manufacturers for intermittent commercial applications, and did not give the required service under Army use in the field. Larger gasoline engines, on the other hand, gave better service and were used on such equipment as mobile laundries and bakeries.

Trailers used during the first part of the war were extremely heavy and large, had high c.g.'s, and were unsuitable on poor roads overseas. Development of improved trailers was undertaken during the war, and in the later stages equipment was available which effected savings in weight, size, fuel consumption, manpower and training time.

Future trend for Quartermaster field equipment development, Levitz believes, is toward further savings in weight and size, since it is believed that a great portion of future armies will have to be transported by air. Future wars, if they come, will be swift, and will not allow time for research and development in all military equipment.

Patent Procedures, Purposes Detailed

by A. M. WATSON, Field Editor

SOUTHERN NEW ENGLAND Section, Feb. 5 – Every mechanic is a potential inventor under the American patent system, Charles L. Shelton believes. Shelton, who is director of the patent section of United Aircraft Corp., expressed the opinion that the patent system is set up largely to protect small business and "the man on the street" who might seek to maintain a profitable business on a new invention and be otherwise unprotected from the production and promotion facilities of a large corporation.

Shelton detailed in his paper on "Patents and the Engineer" the procedure involved in applying for a patent, and the criteria used to determine what is and what is not a patentable idea.

Clean Lubricants Aid Gear and Bearing Life

by MURRAY FAHNESTOCK, Field Editor

PITTSBURGH Section, Jan. 28 – Lubricants are no cureall for troubles originating elsewhere, Joseph M. Sills of Socony-Vacuum Oil Co., Inc., told this meeting. Reporting informally to fleet owners on what they may reasonably expect from lubricants, Sills pointed out that most bearing and gear troubles are caused by dirt, and stressed the importance of keeping lubricants sur-

gically clean by greater care in dispensing and handling.

Subsequent discussion brought out that:

- Aluminum bearings require greater shaft diameter and sidewise clearance for successful use;
- Early troubles with copper-lead bearings were caused by too tightly fitted bearings and unsuitable oils. Now additives are used to prevent such corrosive effects.
- Present tendency is to evaluate oils by performance, not by specifications.

New San Diego Section Elects 1947 Officers

by R. N. YEAGER, Field Editor

SAN DIEGO Section, Dec. 27 – San Diego, established through Council action as the Society's 31st Section, elected officers for the remainder of the Section year. Pictured here are the new officers with some of the governing board members: left to right, Vice-Chairman J. H. Famme, Consolidated Vultee Aircraft Corp.; Secretary-Treasurer D. R. Thomas, Consolidated Vultee; Reception Committee Chairman Henry Mandolf, Langley Corp.; Meetings Chairman F. H. Sharp, Consolidated Vultee; Chairman F. W. Fink, Consolidated Vultee; and Membership Committee Chairman Grant Hodgson, Solar Aircraft Co.

Radical Rear-Engine "Torpedo" Described

by R. J. MARBLE, Field Editor

BUFFALO Section, Jan. 17 – Revolutionary features of Tucker Corp's new rear-engine "Torpedo" were described at a dinner meeting tonight by Preston Tucker, president of the corporation.

Torpedo has a 6-cyl, 150-hp engine; low-pressure fuel injection (eliminating the carburetor); individual wheel suspension; and hydraulic torque converters transmitting power directly from the engine to the rear wheels. It will weigh about 2/3 as much as conventional models . . . dead weight has been reduced by eliminating 800 parts. It will cruise easily at 100 mph and have a top speed of 135 mph.

Low-pressure fuel injection development provides exact fuel mixtures for all conditions without a carburetor, will give about 35 mpg at moderate driving speeds.

Aluminum is used widely in engine and body; total weight saving of 6-800 lb will bring total weight to about 3600 lb.

Piston Failure Causes Analyzed

by J. H. MACPHERSON, Field Editor

NORTHERN CALIFORNIA, Dec. 10 – Significant conclusions reached from piston failure tests on two engines were reported at this meeting in a paper by E. P. Viscia and A. G. Cattaneo, Shell Development Co.

Preignition-type piston failures were induced on a CFR engine with excessive spark advance under high load and temperature conditions. Conclusions drawn, Viscia reported, were that:

1. Large piston-cylinder clearances contributed to failure;
2. Compression ring gap alignment at a hot operating point on the piston crown perimeter accelerated failure;
3. Large ring gap clearances accelerated failure, but to a minor degree compared to the first two causes;
4. Scuff bands, under the conditions used, did not affect failure;
5. Severe scuff marks on the piston surface greatly accelerated the failure.

In tests on the Wright G-200 cylinder, it was possible to induce preignition failures without any of the piston modifications necessary on the CFR engine. Results showed that:

1. Large overall piston-cylinder clearances, together with a ring gap position of the top three compression rings between the piston thrust side and back, produced piston failures without injury to the exhaust valve;
2. Small overall piston-cylinder clearances, even with a ring gap position of the top three compression rings between the piston thrust side and back,

INDIANA SECTION'S PERFECT CIRCLE CONTINGENT

SAE members from Perfect Circle Corp. travel about 75 miles to be present at SAE Section meetings in Indianapolis. The Perfect Circle group shown here consists of (left to right) front row: R. H. Bancroft, Theron Bradshaw, G. H. Keagy, H. C. Rowe, Past-President Ralph R. Teetor, D. C. Teetor; second row: J. Gregg, Section Chairman Karl Effman, C. L. Gough, P. E. Harris, L. Hunter, R. A. Shelly, A. M. Brenneke; third row: H. Eilar, Maurice Bookout, E. Brenneman, M. Estey, J. Bryan, W. B. Prosser, R. M. Thomas; fourth row: M. C. Hunt, E. L. Russell; last row: H. Stech, J. R. Wimbrough, H. McCann, G. Cormany, G. P. Stonecipher.

produced exhaust valve injury without injury to the piston;

3. Small piston skirt-cylinder clearances, even with large ring belt-cylinder clearances and the top three compression ring gaps between the piston thrust side and back, produced exhaust valve injury without injury to the piston;

4. Top three compression ring gap positions between the piston antithrust side and front, even with large overall piston-cylinder clearances, produced exhaust valve injury without injury to the piston.

Detonation studies showed that prolonged knock under severe operating conditions causes severe erosion of the piston crown. Further information on detonation effects was supplied by W. V. Hanley, of Standard Oil Co. of Calif., who described California Research Corp. tests on a Wright G-200 cylinder. After the engine was operated at extremely severe knock for 8 hr, the piston crown was severely eroded, as if by sandblasting. But microphotographs of the grain structure of the aluminum crown indicated that failure had occurred by mechanical erosion rather than by melting prior to erosion. It was concluded that severe detonation would not cause piston ring failures if the piston were adequately cooled. On the other hand, Hanley pointed out, preignition leads to greatly increased piston temperatures which cause melting in some region of the piston crown and burning of the edge of the piston which in turn causes ring failure. Thus preignition is a much more serious type of engine-fuel malfunctioning than detonation. He cited flight test experience to show that piston failures by preignition occurred in as little as 20 sec, whereas prolonged operation under detonating conditions could be tolerated.

O'HARROW

. . . . of Milwaukee

Charles Truman ("Mike") O'Harrow, Milwaukee Section chairman, was born in the very heart of the tractor industry – Charles City, Iowa. He began automotive engineering as a youngster, rebuilding the worst of his automobile-dealer father's trade-ins and selling them at a profit.

His 'teen-age sales and business ad-

C. T. O'Harrow

ventures combined with a mechanical knack to give him a running start after graduation from Iowa State College. He kept going through a tractor design era when innovations were frequent, making steady contributions along the way to his present job as chief engineer of Allis-Chalmers' Tractor Division.

But growing administrative duties never dulled personal aptitudes for doing things with his hands. At home, he is still a first class mechanic. Partnership in a basement shop with his young son Dick has yielded a gasoline-driven motorcycle which Dick's playmates consider a masterpiece of mechanical ingenuity and envy with all their young hearts.

Naturally congenial, "Mike" has a stimulating part in the lives of many friends of all ages. He accompanies his wife to dancing clubs, leads a local group of Cub Scouts, and serves the Milwaukee Section regularly. (He has been successively entertainment, student and program chairman; treasurer; secretary; vice-chairman, and now chairman.) – by L. A. Wilson, Field Editor.

SALTER

. . . . of Wichita

Tom Salter is an aircraft engineer who has little patience with conventional design if new methods represent progress. He is a master of improvisation, with a passion for quality and safety standards. This philosophy carries over from 1928 and his student days at Wichita University, where he first became actively interested in aeronautics. There he built and flew

Tom Salter

gliders while taking his A.B. in business administration and his B.S. in aeronautical engineering.

This aversion to hidebound practices extends to his technical activities, and makes him a vital and effective member of SAE, ASME and IAS.

At Cessna Aircraft Co., where he is chief engineer and vice-president, he is known as a fair and tolerant executive. Outside working hours, however, he is an incurable practical joker, raconteur and cutup. Something of a home workshopper, he creates strange and amazing devices to further his other hobbies of photography, boy scouting and hunting. To keep his basement workshop in one piece and ten fingers on each of the four Salter children, he locks the door and hides the key. – by George W. Baughman, Field Editor.

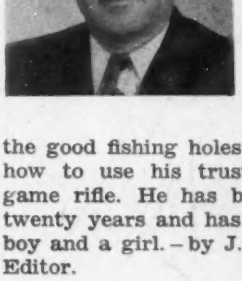
MORSE

. . . . of Oregon

Howard Morse, chairman of the Oregon Section, is a hard working executive who has come up through the ranks to his present position of general manager of Tracey & Co., one of the largest electrical distributing concerns in the Northwest.

Morse's practical knowledge and experience were gained with the Electric Auto-Lite Co. in Toledo, where he attended instruction school and then, as field engineer, conducted electric and carburetor clinics in the territory covered by his firm.

His current responsibility for the successful operation of all Tracey's service departments and sales distribution keeps him busy – but not too busy to find time for his three hobbies. He wields a mean mashie . . . knows all



Howard Morse

the good fishing holes . . . and knows how to use his trusty 30.06-cal big game rifle. He has been married for twenty years and has two children – a boy and a girl. – by J. M. Lantz, Field Editor.

This is the sixth installment in a series of biographies of 1946-47 SAE Section chairmen. Next month three more field editors will report on their Section chairmen.

Steering Performance Importance Emphasized

by C. K. TAYLOR, Field Editor

INDIANA Section, Feb. 13 – Steering performance exerts a direct and indirect influence on operating cost of vehicles, W. K. Creson of Ross Gear & Tool Co. told this meeting. Driver fatigue, safety in operation, and mileage life of chassis parts, particularly of tires, all are affected by the adequacy of steering mechanism design and maintenance.

Operators exert a continuous influence on design, Creson pointed out. However, improvements originating from field experiences cannot always be quickly incorporated in design. The operator therefore is not only interested in design, but learns also to make allowances for operating faults in his vehicles until such time as improvements are available.

Engineers Told Role in Safety

by J. Y. RAY, Field Editor

VIRGINIA Group, Jan. 20 – "Today accidents rank as the leading cause of death among our young people," John F. Creamer of Wheels, Inc., said at this meeting. "We have made impressive strides in controlling disease, but we are still at the pioneering stage in controlling accidents." Creamer's subject was "What Can the Automotive Engineer Do to Promote Safety in the Schools?"

Partial answer, he said, lies in gains already made in the elementary school level through integration of traffic safety instruction with other subjects in the curriculum. Between 1922 and 1944, the fatality rate in this age group dropped 33%.

But the fact remains that during the past 10 years 320,000 people were killed in the United States in motor vehicle accidents, and 110,000,000 more were injured. Economic losses sustained in these accidents totalled about $15,000,000,000.

Educational focal point now, he believes, should be the high school. School-age drivers have a motor-vehicle death record five times worse than that of the 45-50 age group. Strong support to driver-training programs in the schools is imperative to success of the program.

Another fertile field for education is the school shop. Included should be a system of accident reporting and analysis, shop safety inspection and safety instruction. There should be suitable guards for all moving machinery, and protective equipment like goggles, helmets and other safety items.

On the college level, much more should be done along the lines of the program sponsored by the Institute of Public Safety. Every state college, Creamer said, should have a fleet supervisor course to provide scientific instruction for personnel or official and private organizations concerned with traffic safety.

It is the engineer's responsibility, he feels, to contribute his influence and his talents to promoting safety-training programs on all levels of education.

SAE Holds Special Bakersfield Meeting

by R. W. BIXLER, Field Editor

SOUTHERN CALIFORNIA Section, Jan. 24 – T. J. Collins, manager of Cummins Service & Sales, was speaker at a special meeting in Bakersfield sponsored by the Southern California Section. Collins spoke on "Operation and Maintenance of High-Speed Diesel Engines."

Best way to achieve proper maintenance of high-speed diesel engines, he said, is to follow service recommendations of engine companies.

Smoke, he said, is caused by overloading of the engine. To reduce this universal nuisance, he advised letting the fuel pump alone and keeping cool air in the motor.

Evaluates Potential For Airborne Radar

by H. T. QUICG, Field Editor

MID-CONTINENT Section, Feb. 7 – From the first view of radar in ATC use, Frank C. White told this meeting, it was realized that careful and extensive test programs were necessary to determine its value to commercial aviation. Speaking on "American Airlines Evaluation of Airborne Radar," White reported that two types of equipment then seemed most suitable – AN/APS-4 and AN/APS-10 – and most of the evaluation work was carried out on the latter because of its superior display properties. About 250 flying hours have been completed on a special DC-3 to evaluate various types of airborne radar.

Primary use of radar, he pointed out, is to prevent collision with hills or buildings. Other uses have been found, however, such as spotting thunder storms and supercooled water vapors, and making blind approaches to landing strips. Radar is the only blind-approach equipment that will indicate to the pilot when the equipment is not operating properly. Lack of range prevents its use in avoiding mid-air collisions except when one plane is overtaking another.

It will probably cost $2,000,000, White estimated, to equip American's fleet with radar and operate the equipment for a year.

This was an all-day meeting; afternoon session was devoted to reviews of seven important Annual Meeting papers.

ERRATUM

An error was made on p. 94 of the February SAE Journal. In the report of Milwaukee Section's Dec. 6 meeting, Dr. Gustav Egloff was quoted as saying that there are 185,000,000,000 cu ft of gas in known gas fields. The figure should have been 185,000,000,000,000.

SAE Journal Field Editors 1946-1947

Baltimore – Arthur G. Moran
Buffalo – R. J. Marble
Canadian – Warren B. Hastings
Chicago – J. E. Kline
Cincinnati – Harold B. Frye
Cleveland – Wilson B. Fiske
Dayton – J. E. P. Sullivan
Detroit – W. F. Sherman
Hawaii – C. H. Morrison
Indiana – C. K. Taylor
Kansas City – Harold F. Twyman
Metropolitan – Charles F. Foell
Mid-Continent – Harold T. Quigg
Milwaukee – Prof. L. A. Wilson
New England – Arnold R. Okuro
Northern California – J. H. Macpherson, Jr.
Northwest – D. M. Trepp
Oregon – J. M. Lantz
Peoria – Earl S. Tomkinson
Philadelphia – R. W. Donahue
Pittsburgh – Murray Fahnestock
St. Louis – No appointment
San Diego Section – R. N. Yeager, Jr.
Southern California – R. W. Bixler
Southern New England – A. M. Watson
Syracuse – C. W. Simmons
Texas – Earl L. Casey
Twin City – Hamilton Lufkin
Washington – Bertram Ansell
Western Michigan – Carl E. Burke
Wichita – George W. Baughman
British Columbia Group – J. B. Tompkins
Colorado Group – No appointment
Mohawk-Hudson Group – Gene O'Haire
Salt Lake City Group – No appointment
Spokane Group – Harvey Meacham
Virginia Group – Jean Y. Ray
Williamsport Group – Robert B. Ingram

SAE National
AERONAUTIC MEETING (Spring)
Hotel New Yorker • New York
April 9-11

WEDNESDAY, APRIL 9

AIRCRAFT 10 a.m.

C. V. Johnson, Chairman

Use of 75 ST in Structural Applications – George Snyder and F. J. Crossland, Boeing Aircraft Co.

The Experimental Determination of Strains in Aircraft Landing Wheels and Brakes – M. H. Polzin, Goodyear Aircraft Corp.

POWERPLANT 10 a.m.

E. G. Haven, Chairman

Development of Annular Combustion Chambers – Stewart Way and E. P. Walsh, Westinghouse Electric Corp.

Instrumentation for the Development of Aircraft Powerplant Components Involving Fluid Flow – S. J. Markowski and E. M. Moffatt, Pratt & Whitney Aircraft Div., United Aircraft Corp.

TRANSPORT 2 p.m.

R. C. Loomis, Chairman

Automatons for Tomorrow's Aircraft – Hugo Schuck and Gordon Volkenant, Minneapolis-Honeywell Regulator Co.

Electrical Power and the Transport Airplane – E. P. Buckthal, United Air Lines.

GENERAL POWERPLANT 8 p.m.

Arthur Nutt, Chairman

Helicopter Powerplant Installations – R. A. Wolf and C. P. Spiesz, Bell Aircraft Corp.

Future Trends in Aircraft Engine Design – A. T. Gregory and A. L. Pomeroy, Ranger Aircraft Engines.

THURSDAY, APRIL 10

AIRCRAFT 10 a.m.

J. M. Shoemaker, Chairman

An Approach to the Analytical Design of Aircraft – A. B. Croshere, Jr., and H. H. Cherry, Douglas Aircraft Co., Inc.

A Longitudinal Control System for High Speed Aircraft – H. O. Wendt, Curtiss-Wright Corp.

POWERPLANT 10 a.m.

A. L. Beall, Chairman

Detonation and Internal Coolants – E. F. Obert, Northwestern University.

New Methods in Valve Cam Design – W. M. Dudley, Thompson Products, Inc. and Case School of Applied Science, and H. H. Engemann, Thompson Products, Inc.

TRANSPORT 2 p.m.

H. R. Harris, Chairman

Passenger Seats Can Be Comfortable – C. W. Morris, Doak Aircraft Co., Inc.

Integrated Landing Aids – R. D. Kelly and R. L. Champion, United Air Lines.

GENERAL AIRCRAFT 8 p.m.

A. E. Raymond, Chairman

The Development of Naval Aircraft – Rear Admiral L. C. Stevens, Bureau of Aeronautics.

FRIDAY, APRIL 11

AIRCRAFT 10 a.m.

R. C. Bergh, Chairman

Design Features of the Martin 202 Hydraulic System – E. G. Riley and T. C. Hill, Glenn L. Martin Co.

Some Applications of Hydraulics to High Speed, Rotary Drives for Aircraft Accessories – W. W. Thayer, Douglas Aircraft Co., Inc.

POWERPLANT 10 a.m.

L. T. Miller, Chairman

Installation Engineering of Aircraft Turbo-Jet Engines – R. E. Small, General Electric Co.

What Are the Essential Requirements of a Gas Turbine Installation – G. W. Newton, Boeing Aircraft Co.

TRANSPORT 2 p.m.

J. G. Borger, Chairman

The Effect of Civil Air Regulation Performance Requirements on Airplane Design – John E. Steiner, Boeing Aircraft Co.

Suggested Design and Operating Requirements for Cargo Transports – J. E. Winchester, Slick Airways, Inc.

AIRCRAFT 2 p.m.

C. N. Colvin, Chairman

Hermetically Sealing Aircraft Instruments and Control Components – W. A. Reichel, Kearfott Engineering Co.

Aircraft Engine Starters – Ralph Heintz, Jack & Heintz Precision Industries.

Development of Functional Cockpits for Naval Aircraft – Com. Norval Richardson, Bureau of Aeronautics.

DINNER
6:30 P.M. GRAND BALLROOM

W. E. CONWAY, Chairman
SAE Metropolitan Section
W. J. BLANCHARD, Toastmaster
C. E. FRUDDEN, SAE President

Presentation of the Wright Brothers Medal to

F. V. H. JUDD

for his paper "A Systematic Approach to the Aerodynamic Design of Radial Engine Installations"

G. A. PAGE, JR.
Chairman of the Wright Brothers Medal Board of Award

Principal Speaker — OLIVER P. ECHOLS
President, Aircraft Industries Association
"Maintaining Peace through Air Power."

Student Branch News

University of Michigan

THE University of Michigan SAE Student Branch held its first post-war meeting on Jan. 15, 1947. Alexander Brede III was elected chairman to serve with Donald R. Long, vice-chairman, and David G. Gauvreau, secretary-treasurer. Announcement was made by Paul M. S. Stafford, acting chairman, of the retirement of Prof. W. E. Lay as faculty adviser and the appointment of Paul D. Metzler to succeed him.

After the business meeting David Apps, head of the Acoustical Laboratory at the General Motors Proving Ground, Milford, Mich., gave an interesting slide-illustrated talk on "The History of the GM Proving Ground and its Operation." Mr. Apps reported that the Proving Ground was established with two specific purposes in mind. "The first purpose" he stated, "was to aid in the inception and development of new ideas and new models by having a small, isolated world where engineers, unhindered by traffic regulations and without danger to the general public, could perform any tests they desired under all driving conditions. The second reason was to enable the engineers to establish indisputable facts about automobiles in general—to evaluate GM cars against all other products."

Mr. Apps in the course of his presentation screened a series of colored slides illustrating the standard tests conducted at the Proving Grounds.

San Diego State College

On Nov. 8, 1946 the first formal meeting of the San Diego State College SAE Club was held. Alfred S. Sigmund was elected chairman to serve with Harley L. Hyde, vice-chairman, Walter J. Lowe, secretary, William H. Adam, Jr., treasurer, Reba Rogers, program chairman and C. Dale Sutton, Jr. as publicity chairman. Students were ably guided by Vaughan de Kirby who represented the San Diego Section. His assistance was extremely valuable in establishing the new group.

It was decided that the objectives of the group were to acquaint the student engineer with San Diego's industry and to bridge the gap that normally exists between student and engineer, thereby making the graduate more valuable at the outset of his career. This will be done by means of an organized series of programs giving a complete picture of engineering problems which can be divided into three main groups; organization, design, and production.

Prof. Frederick W. Scott accepted the post of faculty sponsor for the group.

SAE NATIONAL

TRANSPORTATION MEETING

Stevens Hotel, Chicago

APRIL 16-18

WEDNESDAY, APRIL 16

TRUCK AND BUS 10 a.m.
S. A. Jeffries, Chairman

Protective Coatings for Increased Life in Bus and Truck Parts
- Electroplating – L. J. Schustic, E. I. du Pont de Nemours & Co., Inc.
- Metal Treatment – V. M. Darsey, Parker Rust Proof Co.
- Organic Finishes – R. B. Davis, E. I. du Pont de Nemours & Co., Inc.

TRANSPORTATION AND MAINTENANCE 2 p.m.
W. A. Taussig, Chairman

Elimination of Causes of Frequent Servicing
- Operator's Viewpoint – T. L. Preble, Tide Water Associated Oil Co.
- Manufacturer's Viewpoint – D. B. Erminger, International Harvester Co.

THURSDAY, APRIL 17

TRANSPORTATION AND MAINTENANCE 10 a.m.
H. L. Hemmingway, Chairman

Fleet Tests of the New Synthetic Lubricants
– D. K. Wilson, New York Power and Light Corp.

TRUCK AND BUS 2 p.m.
M. C. Horine, Chairman

Torsional Suspensions for Trucks and Buses

Problems in Commercial-Vehicle Suspensions and Their Elimination by Torsion Bars
– N. E. Bateson, General American Aerocoach Co.

A Torsional Rubber Suspension System – F. R. Fageol, Twin Coach Co.

Torsion Bar Suspension on Heavy Duty Vehicles – Col. J. M. Colby, Ordnance Department

★

6:30 P.M. DINNER GRAND BALLROOM
W. H. OLDACRE, Chairman
SAE Chicago Section
R. H. JOHNSON and O. A. BROUER, Co-Toastmasters
C. E. FRUDDEN, SAE President
ROBERT L. BIGGERS, President
Fargo Division, Chrysler Corp.

"Wartime Experience Pays Transportation Dividends."

★

FRIDAY, APRIL 18

TRUCK AND BUS 10 a.m.
F. B. Lautzenhiser, Chairman

A Practical Approach to Satisfactory Acoustical Design of Automotive Trucks – Charles Thomas and B. G. Radin, Ford Motor Co.

TRANSPORTATION AND MAINTENANCE 2 p.m.
Howard Willett, Jr., Chairman

Engine Bearings

Sleeve Bearing Lining Materials –1947 – W. E. Thill, Federal-Mogul Corp.

Automotive Bearings from the Service Viewpoint – H. W. Luetkemeyer, Cleveland Graphite Bronze Co.

Oregon State College

A meeting of the Oregon State College, SAE Branch was called to order on Jan. 15 in Chemistry Building by Chairman Lyle Sage. A short business meeting discussed the Branch membership, the Engineer's Bust which was held on Jan. 16, and the Tech Record, campus periodical of student engineers.

After the business meeting, Chairman Sage introduced Harry Manning, field engineer for the Ethyl Corp. from Portland, as the speaker of the evening. Mr. Manning talked, discussed, and showed films on photographing of the combustion that takes place in the cylinder of an internal combustion engine by using a camera which is capable of taking 40,000 to 400,000 pictures per sec.

The group showed great interest and was highly intrigued by the speaker's presentation.

After Mr. Manning had finished his talk, Chairman Sage announced that a closed meeting will be held in February, for members of SAE only at which time an inspection tour will be conducted through a local establishment which specializes in alignment. The meeting was then adjourned.

Northrop Aeronautical Institute

The newly formed SAE Club at Northrop Aeronautical Institute, Hawthorne, Calif., held its first regular meeting on Wednesday, Jan. 29, 1947. The featured speaker was Peter Kyropoulos, faculty adviser of the California Institute of Technology SAE Branch, who supplied valuable information and advice in getting the new group properly organized.

Mr. Kyropoulos stressed the idea that engineering students should try to obtain a broad outlook on engineering as a whole, trying not to specialize to too great an extent. He further outlined the many opportunities an engineering student has to come in contact with the best and latest engineering information through association with the SAE.

The membership was honored further by the presence of E. W. Rentz, Jr., manager of the West Coast Branch Office of SAE. Rentz answered some of the numerous questions regarding organization which have come up in the course of beginning business.

The members were addressed briefly by each of the student officers, who outlined the plans for the future meeting and set forth objectives the organization hopes to accomplish.

The initial meeting was highly successful and a great deal of interest was evidenced by all present.

New York University

First postwar meeting of the SAE Branch at New York University was held on Jan. 16.

Two films were shown, one explaining the welding of heavy parts, the other giving the history of gliders. Plans were discussed to hold meetings twice a month, one to inspect industrial plants, the other, to hear speakers on technical subjects.

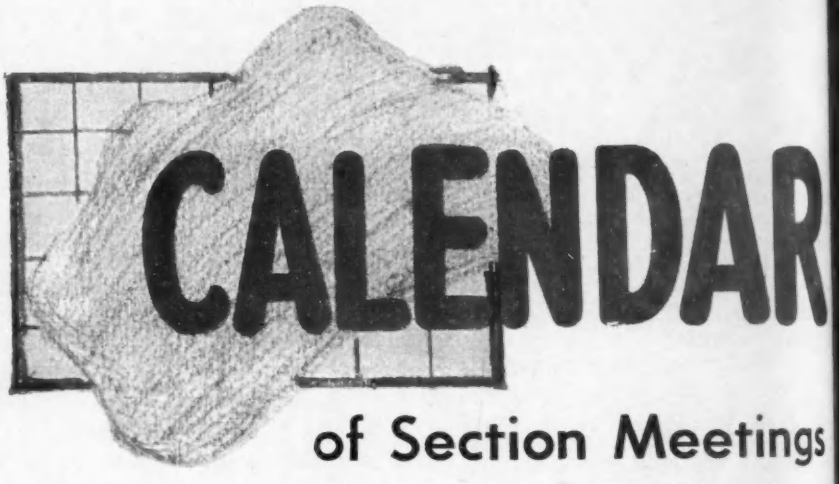
Jerome Persh has been elected chairman of the Branch; Herbert Jaffe, vice-chairman; and George Sonnemann, secretary-treasurer. Prof. E. H. Hamilton is SAE faculty adviser.

California Institute of Technology

Friday, Jan. 10, the Caltech Student Branch of SAE participated in another successful meeting of the Consolidated Engineering Societies at CIT. The speaker was Dr. Lee A. DuBridge, former head of the radiation laboratory at M. I. T. and now president of CIT. His topic was "Radar Techniques."

Dr. DuBridge stressed the capabilities and limitations of radar rather than details of specific types of installations, and indicated what developments will be necessary before radar will be able to completely replace visual observation under restricted visibility conditions. The most important development necessary for this use is a means of generating adequate power at frequencies well above the present top of about 1 cm wavelength. He also demonstrated the relationships existing among range, resolving power, and time necessary to cover a given area which appear to rule out any possibility of obtaining the equivalent of a television image from radar.

Dr. DuBridge ended his talk with a series of slides showing numerous pieces of radar equipment including GCA (ground control approach) equipment which promises to greatly assist in blind landing of aircraft.



of Section Meetings

Baltimore – March 13

Engineers Club; dinner 7:00 p.m. Arc Welding As Applied to Automotive Repairs – Robert H. Davies, consulting engineer, Lincoln Electric Co.

British Columbia Group – March 12

Georgia Hotel, Vancouver; dinner 6:30 p.m. Truck Design – R. C. Norrie, assistant chief engineer, Kenworth Motor Truck Corp.

Buffalo – March 25

Meeting place to be announced. Speaker – C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co., and president, SAE. Guest – Hollister Moore, manager, Sections and Membership Division, SAE.

Canadian – March 24

Royal York Hotel, Toronto; dinner 7:00 p.m. Speaker – C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co., and president, SAE. Guest – Hollister Moore, manager, Sections and Membership Division, SAE.

Chicago – March 11 and 17

March 11 – Knickerbocker Hotel; dinner 6:45 p.m. Hydraulic Controls for Commercial Vehicles – G. W. Pontius III.

March 17 – LaSalle Hotel, South Bend; dinner 6.30 p.m. Some Fundamentals of the Engineering of Structural Rubber Products – E. E. Biaurock, chief product engineer, U. S Rubber Co.

Cincinnati – March 10

Aluminum Industries, Inc.; dinner 6:30 p.m. Plant visitation of the Aluminum Industries, Inc.

Cleveland – March 10

Cleveland Club; dinner 6:30 p.m. Recent Developments in Diesel Engineering – F. G. Shoemaker, chief engineer, Detroit Diesel Engine Division, General Motors Corp.

Colorado Group – March 21

Oxford Hotel; dinner 6:15 p.m. Adaptation of Automotive Equipment and Construction Apparatus to Service Public Utilities – T. C. Smith, engineer of automotive and construction equipment, American Telephone & Telegraph Co.

Detroit – March 3 and 24

March 3 – Horace H. Rackham Educational Memorial Building; meeting 7:30 p.m. Resistance Welding in the Automobile Body – John D. Gordon, general manager, Progressive Welder Co.

March 24 – Statler Hotel; dinner 7:00 p.m. Speaker – Dr. Leo Wolman, National Bureau of Economics. Subject to be announced.

Indiana – March 13

Antlers Hotel, Indianapolis; dinner 7:00 p.m. All-Steel Copper Hydrogen Brazed Cylinder Block – Paul Klotsch, chief engineer, Crosley Motor Corp.

Kansas City – March 20

Continental Hotel; dinner 7:00 p.m. Speaker and subject to be announced.

Metropolitan – March 20

Pennsylvania Hotel, New York; meeting 7:45 p.m. Supersonic and Ultra Modern Airplanes – John Stack, NACA. Joint meeting with IAS. Closed meeting. Open only to members, applicants and service members of both associations.

Mid-Continent – March 28

Oklahoma City, Oklahoma; meeting 8:00 p.m. Some Aspects of Future High Output Gasoline Engines – Robert Cass, assistant to president, White Motor Co. Speaker – R. G. Hilligoss, Bartlesville Bus Co. Subject to be announced.

Milwaukee – March 7

Milwaukee Athletic Club; dinner 6:30 p.m. Stress Analysis – J. O. Almen, Research Laboratory Division, General Motors Corp.

Mohawk-Hudson Group – March 28

DeWitt Clinton Hotel, Albany; dinner 6:45 p.m. Speaker – C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co., and president, SAE. Guest – Hollister Moore, manager, Sections and Membership Division, SAE.

Northern California – March 11

Engineers Club, San Francisco; dinner 6:15 p.m. Open Forum.

Northwest – March 7

Gowman Hotel, Seattle; dinner 7:00 p.m. Supercharging Diesel Engines – Speaker to be announced.

MEETING	DATE	HOTEL
AERONAUTIC (Spring)	April 9-11	New Yorker New York
TRANSPORTATION	April 16-18	The Stevens Chicago
PERSONAL AIRCRAFT	May 1-2	The Lassen Wichita
SUMMER	June 1-6	French Lick Springs French Lick, Ind.
WEST COAST T&M	Aug. 21-22	Biltmore Los Angeles
TRACTOR	Sept. 17-18	Schroeder Milwaukee
AERONAUTIC (Autumn)	Oct. 2-4	Biltmore Los Angeles
PRODUCTION	Oct. 20-21	Carter Cleveland
FUELS & LUBRICANTS	Nov. 6-7	The Mayo Tulsa
AIR TRANSPORT	Dec. 1-3	Continental Kansas City, Mo.
ANNUAL	Jan. 12-16 (1948)	Book-Cadillac Detroit

Peoria – March 31

Northern Regional Research Laboratory Auditorium; dinner 6:30 p.m. Diesel Fuels – Dr. D. P. Barnard, Standard Oil Co. Tour of the Northern Regional Research Laboratory.

Philadelphia – March 12

Engineers Club; dinner 6:30 p.m. Elimination of Combustion Knock – E. M. Barber, The Texas Co.

Pittsburgh – March 25

Webster Hall; dinner 6:00 p.m. Mellon Institute; meeting 7:45 p.m. Factors Affecting the Functioning of Spark Plugs – W. A. Bychinsky, chief ignition engineer, AC Spark Plug Division, General Motors Corp.

St. Louis – March 11

Plant of Wagner Electric Corp., dinner 6:30 p.m. Inspection trip of the Dynamometer Laboratory and Manufacturing Facilities of Wagner Electric Corp. Speakers – G. A. Waters, vice-president in charge of engineering and manufacturing, and Burns Dick, consulting engineer, Automotive Division, Wagner Electric Corp.

San Diego – March 20

Convair Cafeteria; dinner 6:30 p.m. Aircraft and Off-The-Road Tires – James Berry, Fisk Tire Co.

Southern California – March 6 and 27

March 6 – Biltmore Hotel, Los Angeles; meeting 8:00 p.m. Electronic Speed Control of Motors – Industrial Application – B. F. McMamee, consulting engineer, Electronic Equipment Corp. Synthetic Rubber in War and Peace – J. J. Robson, Firestone Tire & Rubber Co. Motion picture.

March 27—Biltmore Hotel, Los Angeles; Speaker and subject to be announced.

Twin City – March 6

Curtis Hotel, Minneapolis; dinner 6:30 p.m. Ignition Progress – Herman L Hartzell, Delco-Remy Dievision, General Motors Corp.

Washington – March 11

Twenty-Four Hundred Hotel; dinner 7:00 p.m. Fuels – Col. G. H. Vogel.

Western Michigan –March 20

Occidental Hotel, Muskegon; dinner 6:30 p.m. Speaker – C. E. Frudden, consulting engineer, Tractor Division, Allis-Chalmers Mfg. Co., and president, SAE. Guest – R. C. Sackett, manager, SAE Detroit Technical Committee Office.

Wichita – March 13

Airway Cafe; dinner 6:45 p.m. Bus and Truck Operation and Maintenance – C. L. Pulis, Santa Fe Trail Transportation. Informal Speaker – W. Blazier, Beech Aircraft Corp.

Plane Service

cont. from p. 69

foreign languages, withstand extreme climates, agree to stay away from home for long periods, and be good mechanics. They are hard to find.

Maintenance of spare parts stocks at each terminal and intermediate station is still another problem. There are custom bonds on import and export of spare parts. Flight delays or cancellations due to lack of spare parts are costly. But keeping a complete stock of spare parts ranging from gaskets to complete radio sets is costly too. Striking the happy medium becomes a crystal-gazing chore.

On the first Swedish Airline trans-Atlantic hop, the plane was delayed 24 hr because of hydraulic troubles that a 5¢ gasket could cure. The gasket was not on hand and had to be flown in from London.

Service and line maintenance expense could be reduced if operators did not prefer their own equipment. Individual passenger steps, ladders, towing trucks, and baggage carts duplicate costs and represent a considerable waste of money. Individual colors on ground equipment is not in line with sound competition – it doesn't better or reduce cost of service to patrons.

Creation of a nonprofit air terminal corporation at Gander Airport is a step in the right direction. (Paper entitled "Transatlantic Maintenance Problems from a European Viewpoint," presented at SAE National Air Transport Engineering Meeting, Chicago, on Dec. 2, 1946.)

SPILLAGE IS WASTE!

THE VENTALARM* whistling tank fill signal for automotive gas tanks, is the answer! VENTALARM assures adequate venting . . . eliminates "dribble" filling . . . does away with the three types of spills: blowbacks, overfilling, and spillage due to expansion.

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Urge Plane Generator For Maximum Service

Digest of paper

By MARSDEN H. PEAIRS

Douglas Aircraft Co., Inc.

GENERATOR installations in air transports should provide a maximum of service for passengers and pilot and a minimum of servicing for ground crew personnel, states Peairs. He shows that:

Selecting generator size is influenced by electrical loads during flight and during ground taxiing. All cabin lighting should be included as essential load so that passengers are not psychologically upset by being told to turn off some lights because of equipment malfunction.

In determining maximum probable combinations and averages to arrive at an outside figure for total load, it is better to take a pessimistic view as to which circuits may be operating at the same time or left on unnecessarily. You cannot assume that every pilot is an electrical engineer; he has enough to think about without being burdened with restrictions on electrical apparatus.

Pilots also expect instantaneous response from electrically-operated equipment.

Since heaviest loads occur at night, all load calculations should be made for this condition. Provision should be made for system reliability and spare capacity because of the nature of essential loads such as electrical propeller controls and deicing, electrical automatic pilot, controls for cabin supercharger, and engine instruments.

Airline experience with generator troubles indicates generator system design could be vastly improved – particularly from a maintenance standpoint – if the following points are considered in design of the installation:

1. Generators should be easy to remove and install. At present, nuts on mounting bolts are inside the generator frame and can be reached only through small holes. Although manufacturers are designing special tools, a better solution is needed.

2. Commutators and internal connections should be welded or silver-soldered to prevent loosening from heat and vibration.

3. The generator air outlet must be screened to keep dropped nuts and washers out of the generator.

4. Normally, thrust is taken on one generator bearing, the other being allowed to float. The floating bearing must be prevented from rotating as this has been known to result in excessive wear and damage.

5. If brushes are movable, the adjustment must be easy to make and lock.

6. Relays should be designed to obviate the need for adjustment change due to hinge pin wear.

Care in initial design of the generator system will eliminate operational and maintenance headaches in service. (Paper entitled "Design of a Transport Airplane Electrical System," presented at SAE National Aeronautic Meeting, Los Angeles, on Oct. 4, 1946.)

Cylindrical Grinding Of SAE 52100 Steel

Digest of paper

By R. E. McKEE

University of Michigan

R. S. MOORE

Quaker Chemical Products Corp

O. W. BOSTON

University of Michigan

BASIC research on removal of metal by grinding has developed a method which can be reproduced to determine the influence of grinding wheels, grinding compounds, and other pertinent factors that may affect the process of cylindrical grinding.

The ratio of the actual amount of metal removed from the work piece to

the amount of wheel wear was expressed in cubic inches. Against this was computed the net power input, giving the characteristic, which was defined by the authors as the volume ratio divided by net hp.

Index Provided

Horsepower per cubic inch per minute and the percentage increase in this factor provided an index to the dulling of the grain in the wheel, sometimes expressed as the self-dressing action of the wheel.

Theoretically, the dulling action of the grain in the grinding wheel face may present a wider cutting edge on a coarse grain than on a finer one, and would require more input hp to remove a metal chip or to burnish the exposed surface of the work. This percentage increase, therefore, aids in evaluating grinding wheels as to their dulling action.

It was found that water-soluble compounds aid in maximum metal removal per unit of wheel wear, require the lowest net hp, and maintain the lowest energy per unit volume factor, but the optimum concentration must be determined for each set of variables in a specific grinding job. (Paper "The Removal of Metals by Grinding," presented at the SAE National Production Meeting, Cleveland, Oct. 14, 1946.)

Equipment Design Key To Swift Air Travel

Digest of paper

By E. S. HAMM

Northwest Airlines, Inc.

SELLING speed in air transportation of both passengers and cargo demands ground and flying equipment geared to rapid handling, counsels Hamm. Detailing design considerations of airline facilities, he observes that:

Whether it's the airplane itself, a taxi apron, or a piece of maintenance equipment, a number of factors should be considered in the design of each unit. Flexibility, standardization, maneuverability, external dimensions, appearance, and operational ease are among the more important elements to keep in mind.

Designing transport aircraft or equipment for future needs is admittedly a difficult task. But design trends should be studied to permit operation with larger aircraft or at least to allow for changes providing for such contingencies. Obsolescence or insufficient capacity in a short time is poor economics.

Equipment standardization should be aimed for by the entire airline industry. Unit costs will be reduced because equipment manufacturers will be permitted to offer production, rather than

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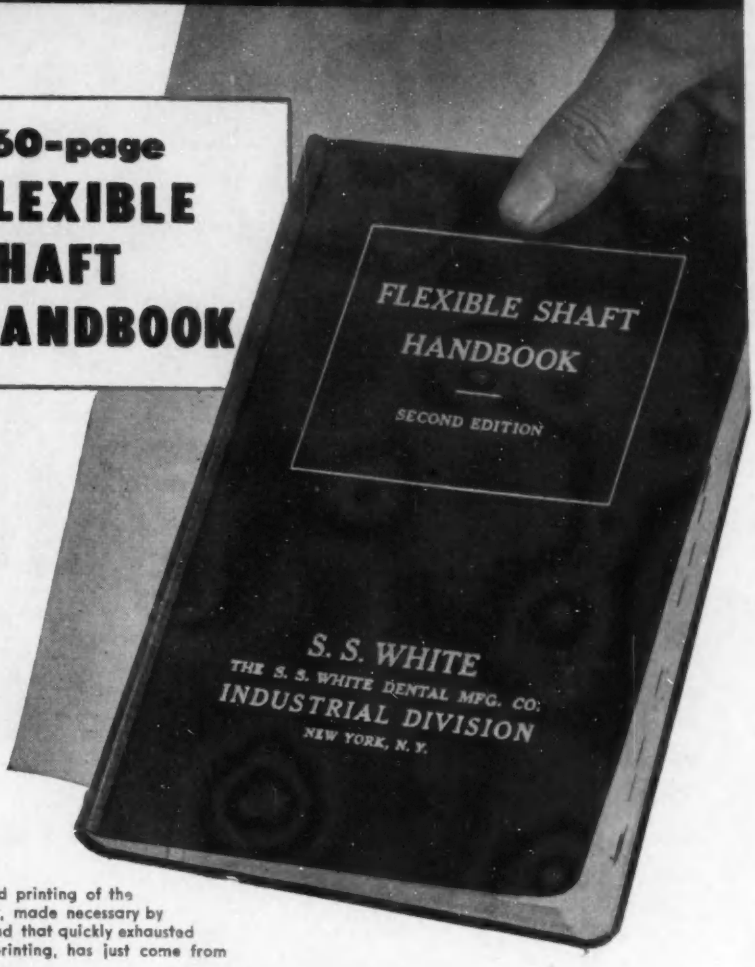

This second printing of the Handbook, made necessary by the demand that quickly exhausted the first printing, has just come from the press.

HERE'S WHAT IT CONTAINS

1. Full information and technical data about flexible shafts for power drive and rotary remote control.
2. Numerous examples of actual power drive and remote control applications in many fields.
3. Full explanations with examples of how to select and apply flexible shafts for specific power drive and remote control requirements.
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special, items. Both capital investment and amount of equipment on the apron will be reduced. An airline operating three types of aircraft might standardize on one adjustable passenger stand instead of requiring three different kinds.

Maneuverability Vital

High maneuverability of service units is a must because of the congestion of vehicles, cables, and hoses around and between aircraft. Mounting air conditioning units and ground power units on trucks is a step in the right direction.

Designing service units for use with several types of aircraft having a wide variety of service outlets and external dimensions, and at the same time not interfering with other ground equipment, is a difficult task. External dimensions and details of all airplanes to be serviced should be closely studied so that best arrangement of the unit can be determined.

Since all apron equipment is visible to the public, it should have eye-appeal. On units such as lavatory service equipment, the exterior design should completely veil the cart's function.

A cardinal consideration for all equipment is that the design should make for a minimum of maintenance and operational cost. Standard designs should employ commercially available parts wherever possible. The design should be arranged to keep personnel requirements – both men and man-hours – to a minimum.

Complex integration of the various phases of airline operation requires careful planning and cooperation between airline engineers, aircraft and equipment manufacturers, and the airport planning engineer. (Paper entitled "Cargo and Passenger Problems as Applied to New Transports," presented at SAE National Air Transport Engineering Meeting, Chicago, on Dec. 3, 1946.)

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Applications Received

The applications for membership received between Jan. 10, 1947, and Feb. 10, 1947, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: E. R. Broden, William B. Shippen.

British Columbia Group: John Frederick DeWolfe, Harry Thomas Dorria, Russell George Hurschman, Arthur Albert Stiffe.

Buffalo Section: Robert R. Bridgman, Carlysle P. Spiesz.

Canadian Section: Pearce C. Armstrong, Austin John Berry, Fred Francis Billing, Clifford Ormond Bower, M. Grant Coates, Eric Lionel Houston, James Lorne Montgomery, James Stewart Munro, Stanley R. Patience, Charles P. Short, Ralph H. Switzer.

Chicago Section: Harry W. Angus, Charles Curtiss Berckhemer, Fred Frank DeMuth, Howard T. Eaton, Jr., Audley E. Harnsberger, Howard H. Kehrl, Donald Yule Milne, Bertel S. Nelson, Donald Kilbourn Plank, George F. Topinka, Milton J. Taup, George H. Webb.

Cincinnati Section: Urban F. Wenstrup.

Cleveland Section: Norbert C. Beerll, George A. Butz, Jr., Daniel William Harmon, Alexander Winton, Jr.

Dayton Section: Donald E. Danielson, Glenn E. Douglass, Jacob Joseph Giancola, Norman F. Trost.

Detroit Section: Donald N. Arndt, Ray M. Belding, Calvin James Bressler, Edward Chernoff, Hubert M. Clark, Richard C. Cook, James T. Conwell, Joseph E. Francis, Jerome J. Frank, Paul B. Hartman, Walter Howard Heginbottom, Edgar Livingston Hollifield, Arthur E. Hoffman, Sigurd M. Kildal, George Walter Mason, Cecil A. McKinney, Robert M. Mortimer, Joseph Emilio Muccioli, Clayton L. Nelson, Roland J. Ostrander, William S. Patyrak, Lawrence L. Pohlman, Madison Post, Rudolph O. Pressman, Albert T. Rittinger, Tunis C. Ross, Jr., Robert A. Schroeder, Philip W. Sloan, Joseph Arthur Sonc, Jr., J. R. Starks, Elmer L. Tandrup, Kenneth W. Tapke, Clark A. Tea, Gervais W. Trichel, John W. Wade, Lloyd E. Webb, Robert Burton Welly, Lawrence A. Werth, Norton Williams, O. W. Young.

Hawaii Section: David Clark, Fred Hedemann, Alfred L. Storm.

Indiana Section: Ivan E. Calicoat, Richard Levi Duncan, Guy O. Hunt, J. E. Knott, Millard Clay Orchard, C. A. Paynter, H. H. Puff.

Kansas City Section: Rupert Allen Jarboe.

Metropolitan Section: Fowler W. Barker, William Victor Caputo, Francis Robert Ewing, R. M. Franey, Irving Granet, Roswell N. Hait, Harry Kee, William Barrett Mark, Leon Resnicow, Robert Schechter, S. Merrill Skeist.

Milwaukee Section: Walter J. Foley, Carl F. Zaitz.

New England Section: Charles Henry Huck, Sol Marder, Ray Schmidt.

Northern California Section: Oliver Paul Cromwell, F. Hal Higgins, Arthur R. Isitt, George M. Paine, Richard A. Ray, Gordon L. Rice, David M. Saenger, Marvin R. Wall, Eugene A. Winslow.

Northwest Section: E. A. Heckendorf.

Philadelphia Section: Arnold Andrew Dach, LeRoy S. Harris, Donald P. Heath, John F. Male, Robert Anthony Moore, John W. Pauli, Joseph William Putt, Alfred E. Townsend.

Pittsburgh Section: Robert Ralston Chrisman.

Salt Lake City Group: James R. Williams.

San Diego Section: Albert E. Heflin, Grant B. Hodgson.

Southern California Section: Alden E. Acker, Roy F. Armstrong, Thomas Walter Boyd, Karl D. Breitigan, C. R. Copeland, Everett M. Gray, Orien L. Hogan, Cedric Leinbach, Kendal Shepard Robinson, Charles F. Thomas, Robert J. Wente, George Thomas Wilson.

Southern New England Section: George S. Budney, Samuel S. Connor, Karl H. Falk, James L. McCoy.

Spokane Group: Clifton J. Nelson.

Texas Section: Walter A. Hoot, Col. A. C. Carlton P. Smith.

Virginia Group: G. Russell Baber.

Washington Section: Ralph R. Elder, Walter L. Flinn, Ivison W. Rhodes, Jr.

Western Michigan Section: Clarence R. Johnson, William J. Nusbaum.

Outside of Section Territory: Robert H. Ammon, Stephen R. Kent, Robert R. Sachnoff, Henry B. Wilmer.

Foreign: George Asselbergs, Holland; Walter Richard Berry, England; Ion Jacques Bochory, Rumania; Raymond George Frederick Griffin, England; Capt. Wan-chun Hsu, China; Ralph Alan Stavert, India.

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New Members Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Jan. 10, 1947, and Feb. 10, 1947.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior, (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: Willard C. Eichelberger (A), Frank S. Moomey (M).

British Columbia Group: C. S. Carswell (A), Ed A. Collins (A), Frank Leslie Hoover (A), James Irving (A).

Buffalo Section: Michael B. Brett (A), Carl G. Pedersen (J), Alfred C. Ryan (A), James W. Westphall (M).

Canadian Section: Henry Lee (J), Elmo C. Maunder (A), Harold Murray McLean (A), Stanley C. Thomas (A).

Chicago Section: Vernal A. Anderson (J), Carl E. Atkins (A), Caesar Benassi (A), Archie Nelson Brion (A), D. L. Davis, Jr. (M), Michael P. de Blumenthal (M), David P. Eastman (M), Herdis G. English (M), Robert H. Gardner (M), Perry L. Houser (M), Chas. B. Johnson (A), Einar John Johnson (J), Eric W. Lager (M), C. Hunter Lindsay (M), Clark R. Lupton (M), Ralph D. Mancinelli (A), John G. Marshall (J), Lawrence Patrick McCarthy (A), George Scott Minium (M), A. Walter Neumann (M), Paul W. A. Oberreutter (J), Leslie O. Parker, Jr. (M), Swen Herbert Stone (M), Virgil L. Van Dinter (A).

Cleveland Section: Joseph H. DeFrees (M), Vincent Ellis (A), W. Douglas Jones (A), Jerry V. Koski (J), James H. Marcum (M), James J. Skelly (A).

Dayton Section: Sylvan E. Connair, Jr. (J), Wilford E. Metzger, Jr. (J).

Detroit Section: John H. Allmand (J), Loren Bartling (J), Robert L. Candlish (J), David O. Davis (A), Wayne H. DeMoss (J), Paul A. Engstrom (J), Louis F. Fisher (A), John Lee Gilmour (J), Jerry M. Gruitch (M), J. Stanley Hoddy (M), Ralph P. Horan (J), K. W. Kithil (A), William H. Kreipke, Jr. (J), John W. Krygier (J), Charles T. Langley (J), Alexander R. Lindsay (M), James A. Line (M), W. A. McKee (M), N. Robert McManus (J), Frank L. Mills (M), Lloyd E. Muller (M), John J. O'Blenis (M), Walter W. Olin (M), James T. O'Reilly (M), Joseph Pickl, Jr. (J), Albert August Rouse (A), Robert W. Seavey (J), Ray E. Spokes (M), Harry R. Stone (J), George C. Trevarthen (J), Mahlon E. Wood (J).

Hawaii Section: Chester E. Frowe (A), Hollis Aiken Hardy (A), Douglas Richards (A), H. J. Roblee (A), Tadashi Tomonaga (A).

Indiana Section: 2nd Lt. Paul E. Chamberlin (J), Leonard O. Edwards (A), David M. Klausmeyer (M), H. A. McAninch (M), I. F. Richardson (A).

Kansas City Section: Harden B. Elliott (A).

Metropolitan Section: Howard W. Aldag (J), Walter C. Alexander (J), Edward L. Asch (M), E. L. Barringer (A), Joseph Edwin Carlton (J), Robert Milton Cokinda (M), Paul Jay Garber (J), Joseph Gilbert (J), David Gordon (M), Frederick Lawrence Horn (J), Gustave Hottendorf (M), Richard D. Kaplan (A), Mark Knapp (J), Herbert Robert Kornblum (J), Robert Stanley Krinsky (J), Albert Edward Lee (M), Andrew Donald Lewis (M), Thomas Hart Odell Newman (A), Frederic H. Pollard (M), Carl H. Search (J), George Robert Sergeant, Jr. (J), Henry R. Sherwin (J), Elbridge M. Smith (J), Harold G. Wenig (J), Ralph B. Wittman (J), Thomas Frederick Wyatt (A), Nicholas Dionisyos Yuelys (J), M. W. Ziegler (A), Julius Edward Zigman (A).

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Mid-Continent Section: John H. Thomas (J).

Milwaukee Section: Michael L. Brumm (J), Wilford B. Burkett (J), Donald C. Galbraith (A), Harry Joseph Johnson (A), Harry F. Minnick (M), Earl L. Monson (M), C. Frank Pervier (M), Wilber J. Petri (M), Richard A. Wolterding (A).

New England Section: Arthur S. Harvey (A), Wm. A. Leary (M), Maurice W. Persson (A), Lewis K. Scott, Jr. (J), Ralph U. Starr (A), Harry E. Williams (A).

Northern California Section: Albert Kemper Branson (M), Ernest H. Gremminger (M), James J. McKinney (A), Charles Edwin Reid-Selth (A).

Northwest Section: Robert Edward Chase (A), Ed F. Oman (A), James Carroll Stuart (J).

Oregon Section: W. P. Currens (A), Ray Mobley (A), Henry Muessig (A), Richard Edgar Smith (J).

Peoria Section: Lawrence L. Brown (J).

Philadelphia Section: Franklin F. Adams (A), William Howard Balentine (J), Hyde W. Ballard (M), Roderick H. Clarke (M), Norman J. Law (A), Robert Meagher (J), Gregory C. Meyer (J), A. Milton Miley (M).

Pittsburgh Section: James J. Logue (A), Kenneth G. Scantling (M).

St. Louis Section: Richard F. Piasecki (J).

Salt Lake City Group: L. Clair Williamsen (J).

San Diego Section: Robert E. Day (J), Edward D. Rohn (M).

Southern California Section: George Douglas Albert (M), Paul M. Bollinger (J), Gordon Niederer Brittle (J), John C. Chiabotti (A), David Stuart Craven (M), Franklin L. Gardner (J), Stanley L. Gendler (J), Thomas W. Gluck (A), E. F. Knoll (J), William James McClure (A), N. Heath McDowell (M), Murray J. O'Toole (J), Frederick J. Robbins (M), William Thorpe (M).

Southern New England Section: Guy E. Beardsley, Jr. (M), Gilmoure N. Cole (M), John Ekizian (J), Etienne Escola (FM'47) Richard W. Henry (J), Richard T. Hicks (J), A. Burton Jones, Jr. (M), William Paul Perrigard (M), Frederick Joseph Pommer (J), Daniel H. Shapiro (J), Fred E. Stockwell (A), Richard S. Woodbury (A).

Syracuse Section: Prof. Neil D. Clark (M), Philip S. Hier (J).

Texas Section: Lt. (jg) James T. Herlihy (J).

Twin City Section: Nels E. Erickson (M), Durward C. Mattison (A).

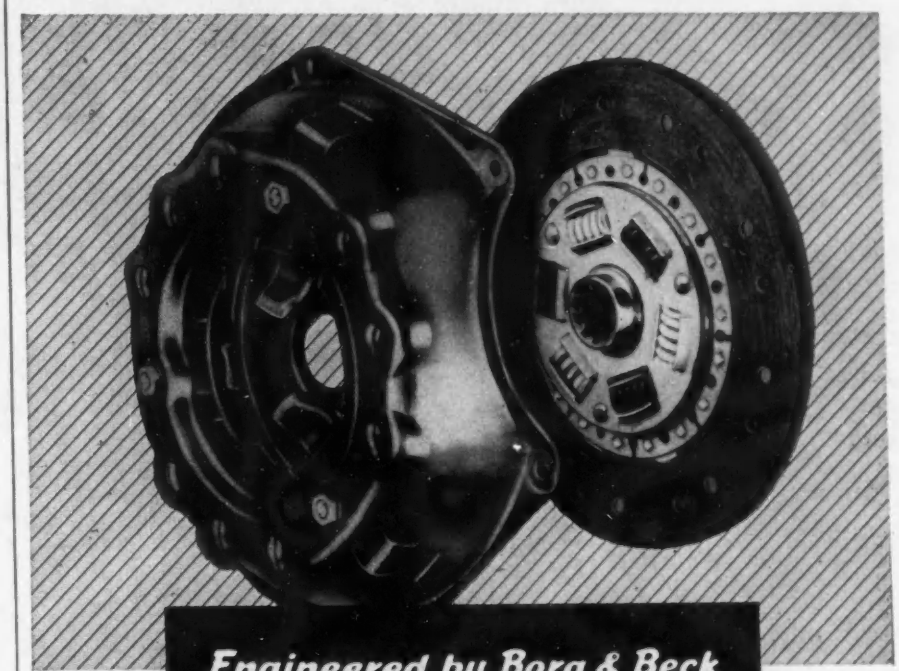
Virginia Group: Henry F. Bickerstaff (A), Howard Ira Minson (A).

Washington Section: Robert P. Carroll (SM), John Fullemann (M), Eugene Louis Klein (SM), Russell P. Proffitt (M), Marion MacKenzie Taylor (J), Howard F. Todd (A), I. Paul Wang (M).

Western Michigan Section: Alfred C. Boorman (A).

Outside of Section Territory: E. C. Barnhart (A), Jacques Cornillon (FM), Fred Errol Davis (M), Duff Green, Jr. (A), C. G. Lord (A), Major S. Gordon Ponder (SM), W. G. Roloson (J), David Lewis Rutter (M).

Foreign: Jean Alger (FM), France; Michael B. Ashman (J), England; Armand Brasquet (A), Argentina; Charles Douglas Carmichael (FM), England; David James Colquhoun (FM), Australia; Michael Stephen Crosthwaite (FM), England; Thomas Gordon Lloyd (FM), England; Andre E. Mandel (FM), France; Theo. Sherwen (FM), England; Alfred Towle (FM), England; Ivan Henry Versfeld (FM), South Africa; Bengt Welin (FM), Sweden; William J. Wigmore (A), South Africa.



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ENGINEERING B-W PRODUCTION

About SAE Members

cont. from p. 78

E. ONLEY was a structural designer with Planet Corp., Lansing, Mich.

THOMAS G. ZSEMBIK, chairman of the SAE Student Branch at M.I.T., has been elected president of the Combined Professional Societies at that school.

Functions of the CPS are to foster the development of the various student chapters of technical societies established at the school, to sponsor meetings of mutual interest to members of the various groups, and to administrate the Stratton Prize Contest for student paper presentation.

As president of the CPS Zsembik will represent all chapters of the technical societies on the Institute Committee, governing body of the school.

ENSIGN WILLIAM FREDERICK SCHELLER, who attended M. I. T., is now serving as engines instructor at the Ground School, Naval Air Station, Corpus Christi, Texas.

A. F. CAMPBELL was promoted from field office manager to division manager, Timken-Roller Bearing Co., Chicago, Ill.

Formerly foundry manager, Wilson Foundry & Machine Co., Pontiac, Mich., **LEON B. THOMAS** is now superintendent of foundries, Sucesores de Abarca, Inc., San Juan (Miramar), Puerto Rico.

ERNEST G. ELLIS resigned as aircraft draftsman for Commonwealth Aircraft Corp., Pty., Ltd., and was appointed project engineer, Aeronautical Supply Co., Pty., Ltd., Melbourne, Australia.

STEPHEN JACK has become junior engineer for Wright Aeronautical Corp., Wood-Ridge, N. J.

Until recently becoming managing director, Esso Development Co., Ltd., London, England, **HUGH CHARLES TETT** was technical adviser, Anglo-American Oil Co., Ltd.

Prior to joining the Western Brass Mills, Division of Olin Industries, Inc., Detroit, as district sales manager, **ROBERT W. POLLARD** was with Western Cartridge Co., E. Alton, Ill.

Having left P. R. Mallory & Co., Inc., Indianapolis, **G. ADOLPH WAHL** became tool engineer for Diamond Chain & Mfg. Co., same city.

Service manager of Titeflex, Inc., Newark, N. J., **GORDON J. WYGANT** was recently promoted to assistant sales manager.

JOHN H. PIKUS who is now design engineer for Spaulding Fibre Co., Tonawanda, N. Y., was formerly connected with the Belleville Township High School as an instructor.

Severing his partnership with Stevens & Wilson Garage, **GEORGE H. WILSON** became service engineer for the Earl A. Marks Co., Portland, Ore.

Previously engineering designer with Lockheed Aircraft Corp., **HAROLD J. VARHANIK** is now serving as design engineer with Beech Aircraft Corp., Wichita, Kans.

Having left Stewart-Warner Corp., Indianapolis, **REUBEN WOLK** has become project engineer, pilotless aircraft, U. S. Navy Bureau of Aeronautics, Washington, D. C.

JOHN WILBUR HORNER has taken on a part time job as laboratory instructor in mechanical engineering at the University of California, Berkeley, while working for his master's degree.

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Realization of the need for faster and more economical transportation led to the creation of sleek, powerful liners that now are but a few days from the farthest port.

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Previously research and design engineer, Bolens Products Co., Division of Automatic Products Co. of Milwaukee, Port Washington, Wis., **L. W. REINECK** is now project engineer of the West Bend Aluminum Co., Hartford, Wis.

T. E. ALLEN, who was affiliated with the Brake Lining Manufacturers Association, Inc., N. Y., is now assistant to the president of the Thermoid Co., Trenton, N. J.

Now head of the office of research analysis, NACA, Washington, D. C., **ROBERT McLARREN** was director of editorial production, Aircraft Industries Association, same city.

Resigning as production manager of Erie Engine & Mfg. Co., Erie, Pa., **GEORGE W. DAGGETT** is now chief engineer and vice-president in charge of engineering, Barrett Machine Tool Co., Meadville, Pa.

Prior to becoming detail engineer for Boeing Aircraft Co., Seattle, **BRADFORD P. DONOVAN** was a student at the University of Wisconsin.

After receiving his discharge from the Army, **JOHN B. DUCKWORTH** became research engineer for Standard Oil Co. of Indiana, Whiting.

Resigning as director of Esso Laboratories, Standard Oil Development Co., Elizabeth, N. J., **DR. P. K. FROLICH** is now affiliated with Merck & Co., Rahway, N. J.

JOHN M. HENDERSON is a student officer at the Industrial College of Armed Forces, Washington, D. C.

RALPH M. HUMPHREYVILLE has established his own maintenance shop called Ralph's Motor Tune Up, Long Beach, Calif.

The board of directors of Thornton Tandem Co., announce the change of their firm name to Detroit Automotive Products Corp., Detroit, Mich.

DUGALD M. BARR who was a lieutenant-colonel in the Army, is now chief of Consumer Goods Branch, War Assets Administration, Miami, Fla.

ROBERT L. BENNETT has been appointed staff assistant for motor vehicles, Southern California Telephone Co., Los Angeles.

Previously assistant chief engineer of Detroit Automotive Products Corp., **EDWARD C. CLAES** is now purchasing agent, Auto Glass Mfg. Co., Detroit, Mich.

ARTHUR FRANCIS MORICCA, mechanical engineer, technical and research division, Texas Co., has been transferred from Beacon to New York City.

ELLSWORTH D. WILKIN has been advanced from assistant chief engineer to chief engineer of Salsbury Motors, Inc., Pomona, Calif.

JOHN YATSKO, a graduate of Ohio State University, is now junior research engineer for Curtiss-Wright Corp., Columbus, Ohio.

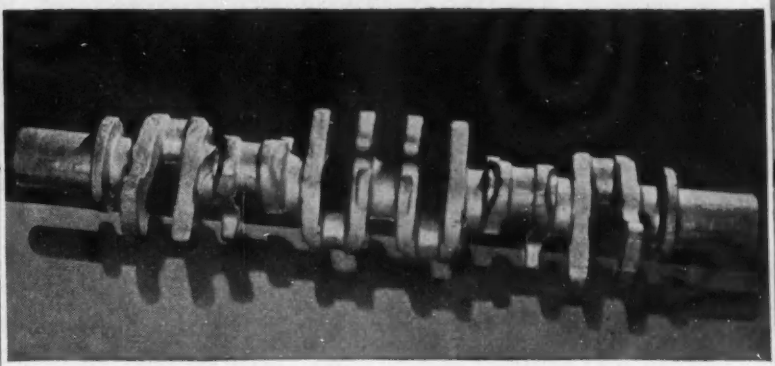
Having resigned from Wright Aeronautical Corp., **R. H. VOGELMANN** has become field engineer with Lederle Laboratories, Inc., Pearl River, N. Y.

ROBERT W. GAINES has transferred from General Motors Proving Ground, Milford, Mich., where he was a project engineer, to Ford Motor Co., Engineering Division, Dearborn, Mich.

Now employed with Schultz Engineering Corp., Brooklyn, as machine designer, **JOHN J. PALERMO** was formerly in the U. S. Army Corps of Engineers.

Now research assistant in the department of mechanical engineering,

turn to p. 107



OUTSTANDING EXAMPLE of modern forging technique—an inline aircraft engine crankshaft forging—a six throw, seven bearing design having twelve integrally forged counterweights. Starting as a straight bar of alloy steel, the material is successively worked through the various forging operations to produce the ultimate shape, having flow lines carefully directed to provide greatest strength in the critical sections.

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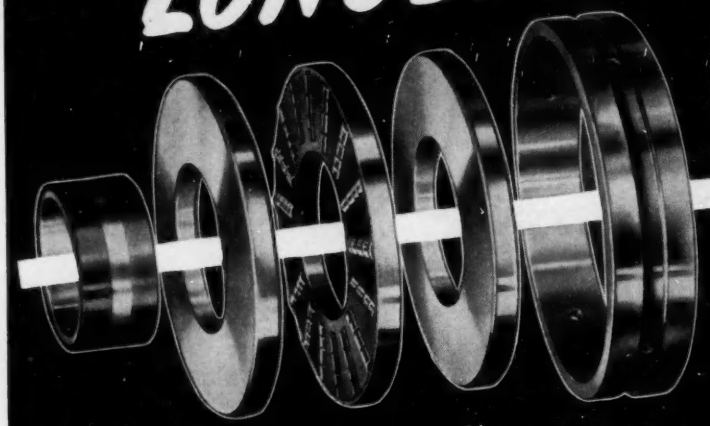

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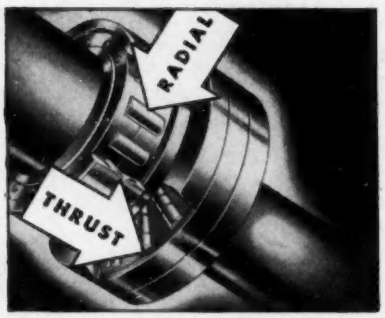
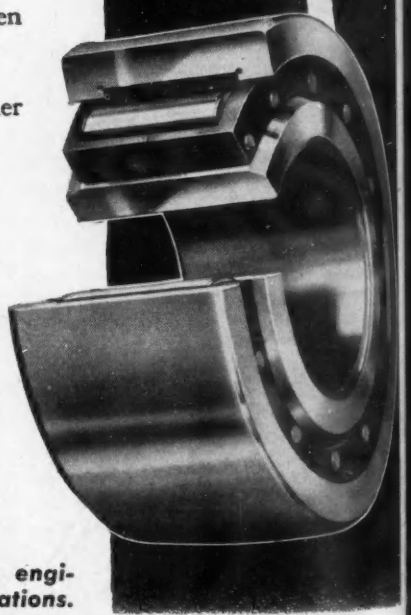
ROLLWAY's Right-Angle-Loaded Bearings have longer life because Rollway uses the principle of *right angle loading*. This splits every load into its component parts of pure radial and pure thrust. Each component load is carried on a separate bearing assembly at a *right angle to the rollers.*

For this reason, Rollway Bearings can use efficiently solid cylindrical rollers of greater mass and cross section area in a given space. The unit load per roller is lower and the load capacity for a given dimensional limit is higher.

As the diagram shows, no oblique loads or resultants, no other compound loads can pile up to increase the magnitude of the simple radial or thrust component. Resistance to shock and vibration is increased. Pinch-out of rollers is eliminated—with less rubbing friction and less wear-back of roller ends. The net gain is clearly apparent in longer bearing life . . . less service attention . . . and lower maintenance cost.



All radial loads carried at right angles to the roller axis. All thrust loads carried at right angles to the roller axis.



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Lehigh University, Bethlehem, Pa., **DONALD S. JOHNSON** was production engineer, Carl L. Norden, Inc., New York City.

FRANK JOHNSON retired recently from Ford Motor Co., Dearborn, Mich. where he had been in charge of all engine design.

JAMES D. MOONEY, JR., of Willys-Overland Motors, Inc. has transferred from Toledo, Ohio, to Maywood, Calif.

Formerly auto adviser, U. S. Army Ordnance Department, **CHARLES A. DOW** is now service manager, Nevada Equipment Service, Inc., Reno.

GARY C. WILSON is now a consulting engineer at Sinclair Refining Co., Houston. He was formerly associated with Tame Co., Atlanta, Ga.

Technical sales engineer with Standard-Vacuum Oil Co., **JOSEPH J. BROWN** was previously affiliated with Tame Co., New York City.

CHAUNCEY J. HAMLIN, JR., has become senior research engineer in charge of muroe rocket motor testing station, California Institute of Technology, Pasadena, Calif.

Until recently chief engineer of Gulberson Diesel Engine Co., Dallas, **W. M. McLAURIN** has joined Hirsch Bros. Machinery Co., El Paso, Texas.

HUBERT NOEL CHARLES has gone into business for himself as a designer and engineering consultant in Birmingham, England. He had been a development engineer with Austin Motors, Ltd., in that city.

ALBERT KRINSKY is now affiliated with National Bureau of Standards, Washington, D. C., as materials engineer.

A former lieutenant in the Navy, **RUSSELL W. RAND** is now serving Caterpillar Tractor Co., Peoria, Ill., in the capacity of research engineer.

JOHN W. TATTER has been appointed assistant to the chief engineer, Firestone Steel Products Co., Akron.

Resigning as service manager of Carbon County Motors, Rawlins, Wyo., **LEWIS E. RICE** has become owner of Rice Auto Service, same city.

J. RAYMOND STEVENSON, formerly with Graham-Paige Motors Co., is now designer of farm tractors, Ford Motor Co., Dearborn, Mich.

THEODORE F. WALKER has been promoted from project engineer to chief plant engineer, Kent-Moore Organization, Jackson, Mich.

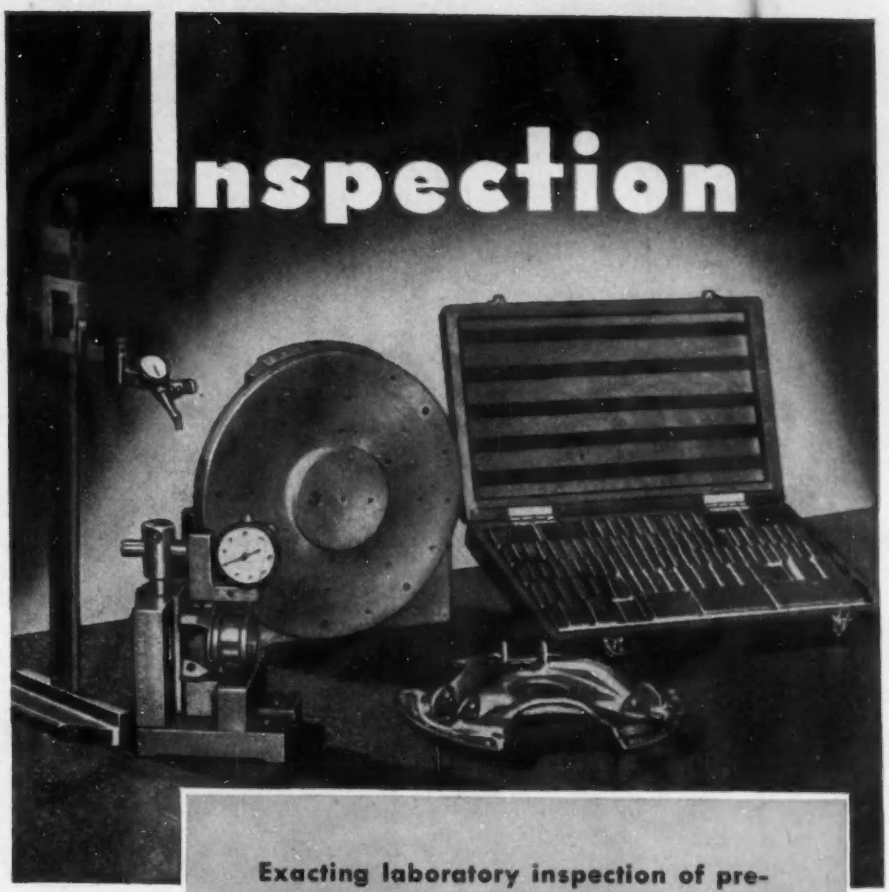
Schneider Mfg. Corp. has been formed by Schneider Brothers Co., as announced by **A. G. SCHNEIDER** and **HEINRICH SCHNEIDER** partners. The Mfg. Corp. has taken over the activities of the former manufacturing division of Schneider Brothers Co., and has been granted license to manufacture, use and sell hydraulic torque converters and transmission mechanisms under the patent right of Schneider Brothers Co. Offices of both companies and the manufacturing plant are located in Muncie, Ind.

ALFRED C. SMITH has joined Willys-Overland Motors Inc., Toledo, Ohio.

EVERETT H. KANDARIAN has been promoted to quality engineer at Pratt & Whitney Aircraft, East Hartford, Conn.

ETHAN A. BERRY, now affiliated with Jandor Inc., Dayton, Ohio, was formerly with Johnson Tool & Engineering Co., same city.

Having joined J. I. Case Co., Rockford, Ill. as project engineer, **HAROLD V. HANSEN** was formerly associated with Harry Ferguson, Inc., Detroit.



Exacting laboratory inspection of precision parts, in addition to regular spot and production line inspection of all parts, assures the Atwood Clutch customer of a precision product that consistently conforms to the original specifications.

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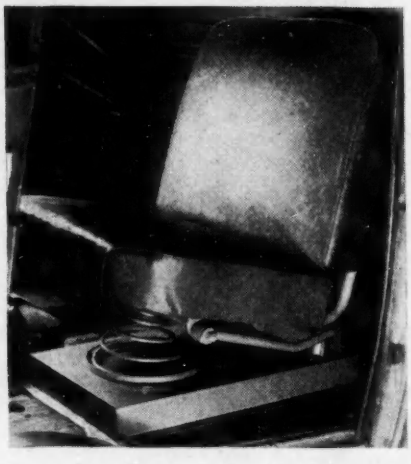
The Monroe *Hydraulic* E-Z Ride Truck Seat, built to carry the driver and no other load, provides the much needed comfort for long money-making hauls.

Monroe *Hydraulic* Shock Absorber works in unit with *variable-rate* coil spring to provide an easy ride to drivers of any weight. Pivot point and stabilizer bar control side-sway. Seat helps guard against disability claims.

Now available for 1928-47 Dodge, International, GMC, Ford and Chevrolet Trucks. Monroe engineers are always ready to assist you.



The Monroe *Hydraulic* E-Z RIDE TRUCK SEAT is constructed with seat and back cushions of either coil springs or foam rubber. Back-scrubbing is eliminated, giving upholstery longer life.

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Prior to taking his present job as layout draftsman at U. S. Plywood, New Rochelle, N. Y., **FRANK A. PALONE** was draftsman at Republic Aviation Corp., Farmingdale, L. I., N. Y.

Recently resigning from Bendix Aviation Corp., South Bend, Ind., **JAMES A. BOLT** is now associate professor of mechanical engineering at the University of Michigan, Ann Arbor.

CLIFFORD E. WILLIS recently became staff engineer at Fairchild Aviation Division, Hagerstown, Md. He has been senior development engineer, Weatherhead Co., Cleveland.

EDWARD B. HILL of Gar Wood Industries Inc. is now located in Wayne, Mich.

After graduating from the California School of Applied Science in January, **ROGER L. ATKIN** is now connected with Owens-Corning Fiberglas Corp., Newark, Ohio.

CARROLL J. WILSON has become owner of Wilube Oil Co., Buchanan, Mich. He had been with Mergraf Oil Products Co., Detroit.

Having been discharged from the U. S. Army Air Forces, **JOHN W. CRESSE** has become service-sales development supervisor at Pacific Airmotive Corp., Burbank, Calif.

GEORGE C. SCOTT, JR. has joined Gulf Oil Co., Boston, as a lubrication engineer.

Formerly superintendent of engineering planning at Trans World Airlines, Kansas City, **R. W. RUMMEL** has been promoted to director of aircraft procurement.

THOMAS L. JACKSON resigned recently as engineering design scheduler and estimator at Boeing Airplane Co., Wichita, Kans., and is now management engineer, office of the president, Willys-Overland Motors, Inc., Toledo, Ohio.

Previously in the Armoured Fighting Vehicles Division, Ministry of Supply, London, **ALFRED R. CODE** recently became associated with Silentbloc Ltd., London, serving in the capacity of executive engineer.

Associated previously with SKF Industries, Inc., Philadelphia, as executive vice-president, **S. F. WOLLMAN** is now connected with Hartford Empire Co., Hartford, Conn.

SAE members recently elected to the board of directors at the Automotive & Aviation Parts Manufacturers, Inc., Detroit, are **ROBERT H. DAISLEY**, vice-president of Eaton Mfg. Co., Detroit; **F. C. GREENHILL**, president of Acklin Stamping Co., Toledo and **CLARENCE C. CARLTON**, vice-president and secretary of Motor Wheel Corp., Lansing, Mich.